Volume 63

American Machinist

Number 25

New York, December 17, 1925

How Two Men Handle 1,000 Flues a Week

By Frank C. Hudson

The apparatus and methods that enable the Grand Trunk Shop at Battle Creek to handle boiler and superheater flues at very low cost

THE handling of boiler flues, from the time they are taken out of a locomotive until they are ready to go back into place, is more of a problem than may appear at first glance. They must be cleaned, the ends cut off and the safe ends welded in place, and the joints must be tight under heavy pressure.

While there are a number of methods of cleaning flues used by various railroad shops, the disappearing tumbler shown in Figs. 1 and 2 has been found very satisfactory at the shop in question. In Fig. 1, the tumbler, or cleaner, is in the lowered position with the doors open to receive the load of flues shown on front of it. It will hold 40 superheater flues or 250 flues of 2¼ in. diameter. The overhead crane places the flues on the portable inclined rack. As soon as the shackle that carried them has been removed, they roll down the incline into the drum of the tumbler. The doors are then closed and locked, and the machine set in motion. It is driven by a 20-hp. electric motor, operating at a cost of 22c. per hr. for power.

The construction of the tumbler and the design of the portable racks can readily be seen in both Figs. 1 and 2. For unloading the tumbler is raised above the pit, as in Fig. 2, and the flues are allowed to roll out into the rack shown. The doors of the tumbler are shown open in Fig. 2, while the doors that close over the pit are shown hooked back in Fig. 1. Both views show the hydraulic cylinders at the ends, by which the tumbler with its load, is raised and lowered, this installation being somewhat unusual.

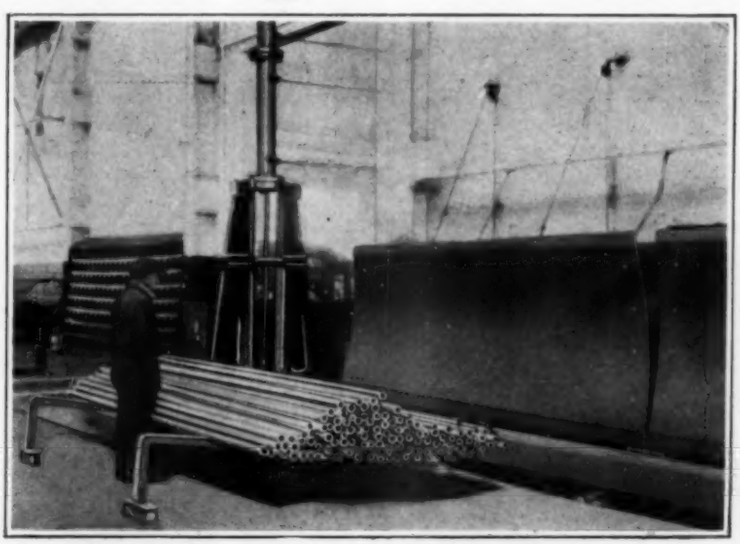


Fig. 1—The tumbler ready for loading

The overhead crane removes the flues, after cleaning, from the curved arms into which they roll when the tumbler is opened in its raised position, Fig. 2 The handling expense is thus reduced to a minimum, since the time taken to load, unload, change water in the pit, and oil the bearings is approximately but 38 min. of one man's time.

In Figs. 3 and 4 are shown the different operations of repairing 2-in., 2¼-in. and 2½-in. flues. The first operation, after being received from the cleaner, is to cut off and scarf the ends slightly on the Bignall & Keeler cutting-off machine shown at the right in Fig. 3. This machine has been adapted to cut off flues up to 5½ in. in diameter and one man can cut off 2-in. flues at the rate of 240 per hour.

The second operation is the cleaning of the safe ends and the ends of long flues, preparatory to electric flash-welding them. The cleaning is done on a Production Machinery Co.'s endless canvas-belt polisher. One man can polish 750 safe ends or 425 flue ends per hr. on this machine.

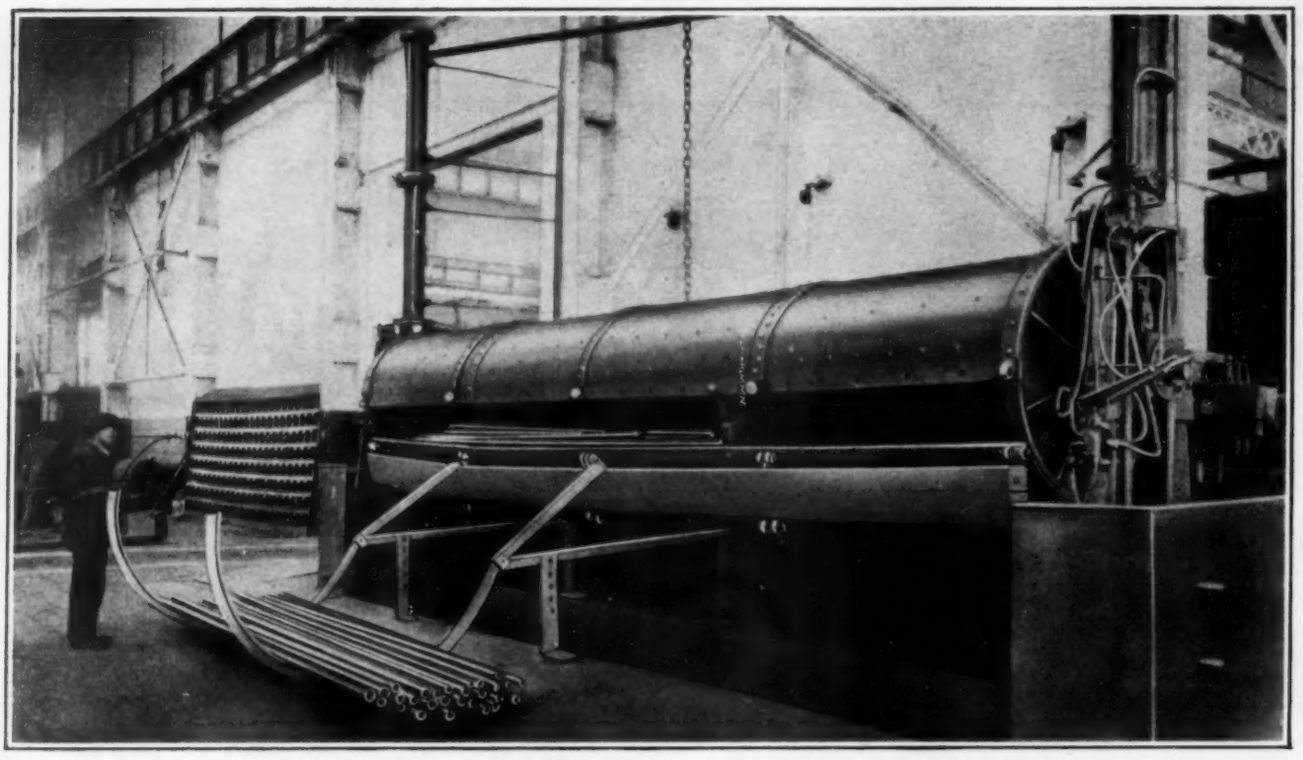


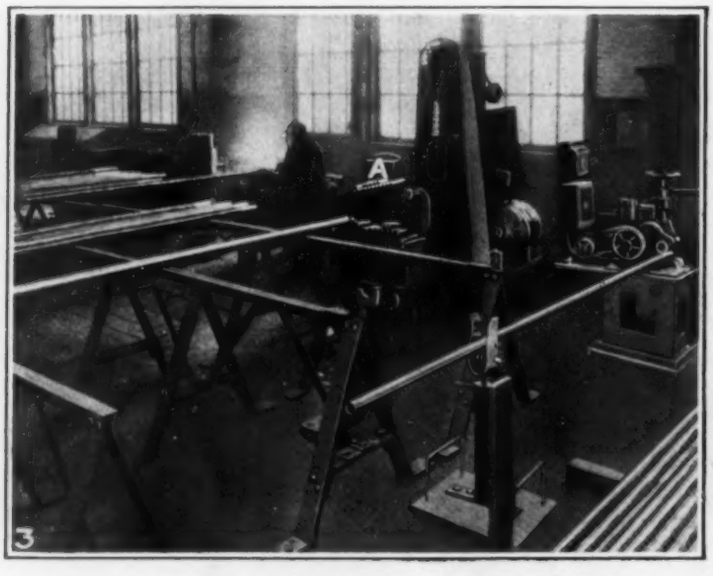
Fig. 2—Unloading the flues by gravity

The third operation is the flash welding of the safe ends to the flues on a Thomson electric welding machine, one man welding 2-in. or 2¼-in. flues at the rate of from 65 to 70 per hr. By the use of two operators, the output can be increased to 115 per hr. when necessary. It is hoped that the use of the oil furnace for heating for the swaging operation will shortly be replaced by the electric process of heating. One man can swage from 150 to 200 flues per hour.

The operation of cutting to length for the front end, takes two men, who cut and expand 85 flues per hr. The cost of electric current for 2-in. flues is 24c. per 100, or slightly less than ¼c. each. These figures are not given as any sort of a challenge or with the idea of their being exceptional, but merely as a detail of what is being done in the flue department described. Perhaps others can show even better results, but this is at least something from which a comparison could be started.

The operation of welding safe ends on superheater flues is shown in Figs. 5 and 6. The welding machine is a Federal and the hammer is a J. T. McGrath flue welder. This operation takes two men, who complete from 13 to 16 flues per hr. The actual heating time is 45 sec. each. Current cost 90c. per 100 welds.

None of the flues welded by the machines described are tested before being put in place in the boilers, and less than one per cent of superheater flues, and 0.10 per cent of small flues have been found defective at the electric weld. Thus it is cheaper to cut out a leaky flue tested in the boiler, than to test each flue after welding.



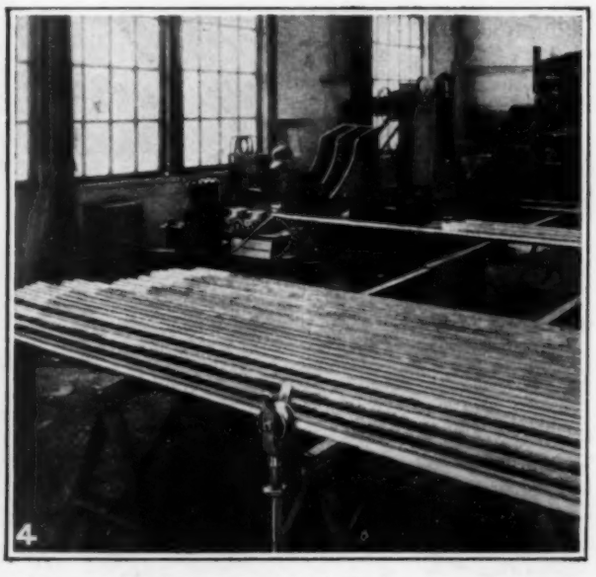
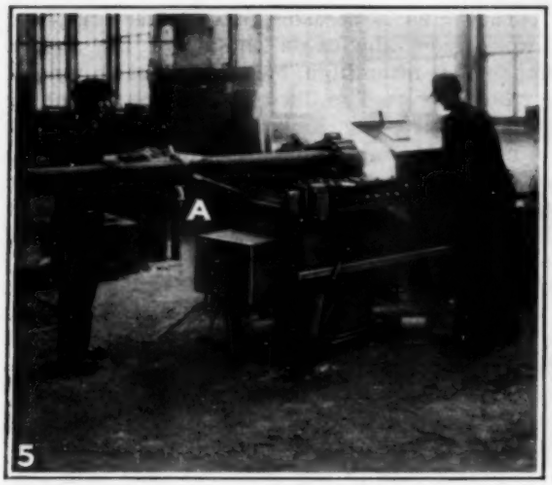


Fig. 3—The welding department. Fig. 4—More details of flue repairing



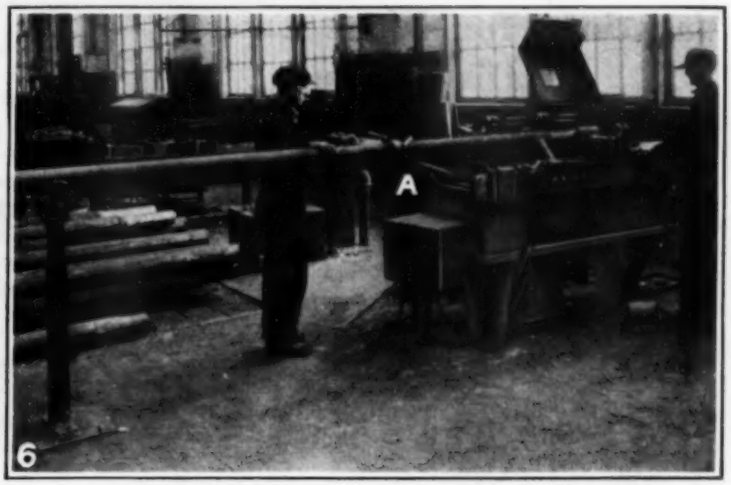


Fig. 5—Welding a superheater flue. Fig. 6—After the weld

The convenience of the racks on which the tubes are handled has much to do with the output of these two men and the low cost at which the work is done. In Figs. 3 and 4 the construction of the racks, as well as their arrangement, can be seen.

The outer end of the flue is held on a roller support while the end is being cut off, after which it is an easy matter to swing the cut end on the further rack and so reduce the weight to be lifted. The flues are then rolled to the adjoining polishing machine where the outsides are cleaned. The welding machine is next in line. The safe ends are waiting at *A*, Fig. 3, so as to save time in the welding operation. Beyond is the swaging

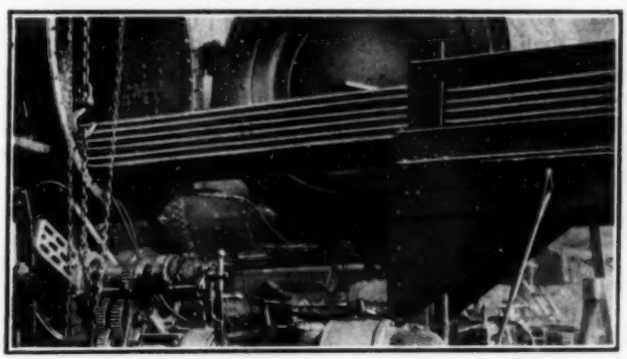


Fig. 7—Rack for handling flues in erecting shop

hammer for smoothing down the flash raised in welding. Another one of the hammers can be seen in Fig. 4 which also shows the way in which the racks are used. The flues in the foreground have been finished on the left ends.

In handling the larger superheater flues for welding and for swaging, it has been found helpful to use the clamps shown at *A* in Figs. 5 and 6. They are easily and quickly put on and taken off and make it much easier to turn and otherwise manipulate the flue.

When the flues are ready to leave the welding department they are placed in special racks that hold the ones from the locomotive and are carried by the crane to the proper track in the erecting shop. The end of one of the racks with the flues in place is shown in Fig. 7. Stands are provided so that the flues are held at the right height above the floor as can be seen. This method prevents blocking the shop floor with a pile of flues and also saves much time in the handling by those who put them in place. By placing them at the proper height, the men are saved much stooping and lifting. It is handling devices of this kind that not only save time but make the work easier. They are appreciated and pay dividends in several ways.

In spite of the modesty of the men in charge of this plant, it seems to be out of the ordinary when it comes to costs of handling and safe-ending boiler flues.

Dealing With the Outside Inventor—Discussion

By I. B. Rich

Messrs. Leach and Koch, whose interesting article appeared on page 902, Vol. 63 of the *American Machinist* have evidently had experience with only one side of the case, and presumably with manufacturers who at least know that there is such a term as business ethics. The demand for a minimum royalty grew out of the necessity of the inventor to protect himself.

Long years ago, a friend of mine invented a bench vise. He took it to the largest vise builder in his locality who enthused over its merits and offered to build it on royalty. My friend was naturally much pleased, signed a contract giving the sole right of manufacture at a liberal royalty, and began to dream of an income for his declining years.

True to the contract, the vise builder started the manufacture, but he built only *one* solitary vise, enough to cover the law, and paid the royalty. Then he tucked it away on the shelf, where it couldn't attract attention away from his regular product. It was experiences of this kind that made inventors wake up to the necessity of demanding a minimum royalty.

I agree that there might perhaps be a cancellation clause after a stated period. But having known several cases closely akin to the one cited, I cannot see that a minimum royalty is such an outrageous demand.

Erratum

In our issue of Nov. 12, the name of the author of the article, "The Elimination of Waste in Belting and Transmission Equipment," was given as W. E. Nicholls. It should have been W. W. Nichols.

Vacations for Wage Earners—Discussion

By D. C. Wright

THE writer was a little surprised some weeks ago to see in the *American Machinist*, page 142, Vol. 63, an item under the above heading, conveying the general impression that any plan, under which such a thing was possible was more or less in the nature of an experiment and was just receiving its tryout.

It is true that since the earlier days of industry down to comparatively recent years, it has been rather taken for granted that the salary-drawing portion of an organization was to get a vacation, but any suggestion that the "hands" were to be similarly blessed, was carefully avoided.

Just why it should ever have been originally conceived that a "white collared" clerk was ordinarily so exhausted by his strenuous desk work as to require revivifying, while the actual producer, who put in long hours at shop work that frequently was exhaustingly heavy, was expected to draw his renewal from some inner fount, is hard to explain.

Favoring the "White Collar"

Neither, for that matter, is it easy to comprehend the fairness of a plan, by which in the event of illness an employee on a salary is carried at full pay for a considerable length of time, while the man on an hourly rate is docked for his slightest absence during working hours. The simplest explanation for both of these procedures is merely to say that they were followed because it was possible to "get away with them."

Having put in the last fifteen years in work, wherein the matter of labor turnover assumed major importance, and having been personally interested in this phase of industry, the writer is rather inclined to doubt the soundness of any argument that the high turnover of shop labor is a reason for withholding vacations from this end of the organization. The natural tendency among men is to hold a job. Such a tendency is predicated upon a human inclination toward something steady and sure. As in the higher realms of business, the entrepreneur class is only a small percentage of the total, so in the wage earning class the deliberate "floater" is in the minority.

True, there are a large number that "float," but these have for the most part some definite reason for moving on, and most of the reasons can be traced directly to the plant, the department, the supervision or other conditions attendant upon that individual's connection with the organization.

Vacation Privileges vs. Labor Turnover

One large corporation took pains to create statistical records, which in my estimation illustrated the point that I have in mind, and I feel that a review of similar records in other corporations will reveal identical conditions, namely, that the turnover arising from a voluntary separation of the individual from the payroll is to a large extent among the lower grades of jobs, common labor and the like. The better class of jobs in any plant, where conditions of supervision are such as to create a feeling of desirability, fair play and wholesome surroundings in the mind of the employee, have a comparatively small percentage of "quits."

Such turnover as is occasioned by retrenchment or lack of work from any cause outside of the control of the employee is often high, but should not be figured into any rate to be used as illustrative of real turnover and cannot be properly advanced as an argument against a reasonable extension of vacation privileges to the wage earners. As a matter of fact, the percentage of voluntary turnover among the lower grades of salaried employees is usually about as high as that of the shop payroll, when based upon the actual total number employed in each case.

Abuse of Benefits

Supplement these points with the additional knowledge that no plant office boasts greater loyalty or devotion to the company interests than is found in the hearts of the old-timers of the shop organization, and it is incomprehensible to any practical shop man that any attempt to justify a distinction between the policies toward the salaried and non-salaried personnel should be made.

A reasonable protection against abuse of any system of benefits is unfortunately always necessary, as in the shops of our country as in other walks of activity, there is that ever-present class of persons, whose aim in life seems to be to get as much for nothing from the other fellow as possible.

On the other hand, the spirit of fair play, which ultimately is bound to actuate all successful relations between individuals or groups, and whose presence or absence is constantly under critical observation by the mass of us in our dealings with others, dictates that this protection be applied equally against all classes in the organization.

Certainly from the standpoint of the employer "reasonable protection" should demand some plan by which the sincerity and value of the employee as a reliable, useful arm of the organization is established. As with other marks of appreciation, so is it folly to leave the allotment of vacations in such form as to make it easy for the undeserving to win.

The Contributory Plan

As a general proposition, the matter of steady service is about the most simple, sane and fair basis upon which to allot vacations, and in justice to the employee, his or her connection with the organization should be figured without reference to any involuntary separation from the payroll, where such separation is made necessary because of reasons beyond the employee's control. In other words, an old employee with a clean record should not be penalized by reclassification as a newcomer, merely because slack work might compel his temporary lay-off.

Any system for allotting vacations or other rewards that employs a method by which the employees themselves must contribute a certain amount in consideration of a further amount contributed by the employer, is wrong. As an incentive to thrift and saving, the so-called "contributory plan" is of service in that it furnishes that ever-desirable element of "something for nothing," but in any program calculated to furnish a form of reward for merit, the gift should be one with no strings attached. Nothing gets under the hide of any employee so much as dictation from or interference by his employer in his personal affairs, unless it be a feeling that things are being handled in an unfair manner.

Automotive Production

Building Diesel Engines for the Panama Canal

By Frank W. Curtis
Associate Editor, *American Machinist*

Specifications of the units — Assembling bedplates — Planing cylinders — Turning pistons — Machining cylinder heads

THE increasing demand for the larger sizes of Diesel engines for various purposes is causing the development of units of unsual size that have created considerable interest among the engineering profession. This tendency of advancement is shown by the construction of three engines of 3,750 hp. each, for the Panama Canal Commission, now being built by the Nordberg Manufacturing Co., Milwaukee, Wis. The engines are the largest in size that have ever been attempted by an American manufacturer and are far in excess of any Diesels now in use in this country.

The engines are to be installed at Miraflores to operate in connection with a hydro-electric plant, providing standby service used in connection with the operation of the canal. During the dry season it is necessary to have additional power to take the load that the hydro-electric plant cannot supply, this being at present supplied by a steam-turbine plant. The reason for installing the Diesel engines is that they can be quickly started and show practically no expense when idle, whereas the present steam equipment must be kept in continuous operation at a rather large expense. It is expected that the Diesel installation will show a remarkable saving in operating cost. The engines are of the two-cycle type and arranged for valve-in-head scavenging, four valves in each head being opened simultaneously, admitting a large quantity of air at low pressure. This action expels all the dead gases from the cylinder and leaves it filled with pure air for the next power stroke. The air is supplied by duplex scavenging pumps while the air for the fuel injection and starting is furnished by a three-stage high-pressure air compressor, both of these units being driven from the crankshaft. Each engine is a complete plant in itself and equipped with indicators, thermometer, pyrometers, tachometers, overspeed safety stops and remote control of the pumps.

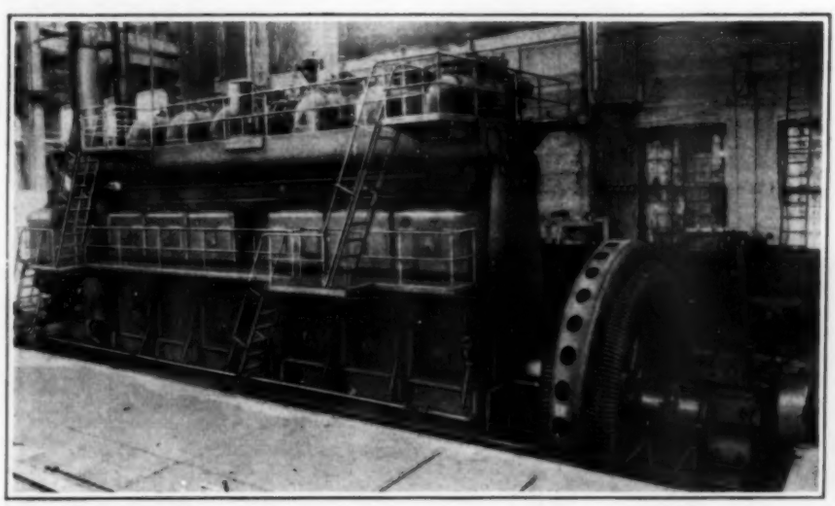


Fig. 1—One of the completed Diesel units

Size of Units

Each unit will have six cylinders, of 29-in. bore and 44-in. stroke, and operate at 125 r.p.m. They will be directly connected to a 3,125 kva., 3 phase, 25 cycle, 2,200-volt generator of the flywheel type that will eliminate the use of a flywheel on the engines. The units are rated at 3,750 hp., but carry a 10 per cent overload, rating each unit at 4,125 hp., or a total of 12,000 hp. for the entire installation.

The size of one of the units may be judged by the view shown in Fig. 1.

AUTOMOTIVE PRODUCTION

The weight of the combined engine and generator is slightly over 1,000,000 lb., the height from floor to floor 22 ft. 6 in., the width 21 ft. and the length 62 ft. The first unit, recently completed, started immediately on the first attempt and completed a thorough test that called for a 24-hr. non-stop run under various loads ranging from no load to 110 per cent load.

The illustration in Fig. 2 shows the bedplate and

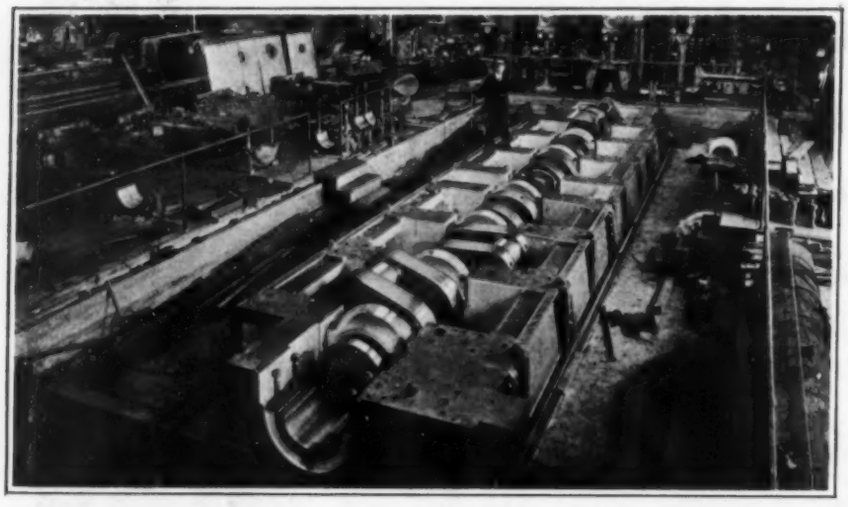


Fig. 2—View showing crankshaft and crankcase assembly

crankshaft assemblies. The crankshaft is of the built-up type and has a drilled passage throughout its entire length for the distribution of oil from the pressure system to the crankpin bearings, crossheads and other units. The total length of the crankshaft is 57 ft. 6 in. Fig. 3 shows one of the eight sections of the bedplate being machined on a 10-ft. planer. Two sideheads and two crossheads, fitted with special forged tools, are used for finishing the various surfaces. The work is held on the machine by four clamps. Approximately $\frac{3}{4}$ in. of metal is removed in two cuts, the sizes being held to a 0.005-in. tolerance. The slot shown at *A* is fitted with a key that also fits a corresponding slot in the bedplate section fitted to it at assembly. This construction insures accurate alignment of the units. The slot location is made from the top face of the bedplate, shown next to the table in the illustration, which has been machined at a previous operation. Its position is held without any tolerance, while the width is held to a limit of ± 0.001 in. As the weight of the work is sufficient to withstand the greater portion of the pressure of the cut, it is not necessary to arrange a complicated clamping method.

Another planing operation, shown in Fig. 4, is that of finishing the top and four sides of the cylinder casting. The work, made of cast iron, has been bored and machined on the bottom side, from which surface the cylinder is located on the table of the machine. Four clamps *A* hold the work in position, while two adjusting supports *B* are used to give rigidity and strengthen the location of the work against the pressure of the cut. The top face is finished to size, requiring the removal of $\frac{1}{2}$ in. of material. The height of each of the set of six cylinders must correspond and check with one another. The scavenging and exhaust port sides are then planed to size, after which the work is turned around 90 deg. so the other two sides are in correct relation for machining. From this operation, the cylinder has various drilling operations performed on it, and is then cleaned, tested, assembled with the liner and studs and transported to the pit, shown in Fig. 2, for assembly. The inspection includes a hydrostatic test, made on all the Diesel-type engines made by the company.

In Fig. 5 is shown the operation of turning one of the compressor pistons used in the Diesel unit. The work is cast iron, hollow in form, 5 ft. $2\frac{7}{16}$ in. overall length, 28 in. in diameter at the large end and $24\frac{7}{16}$ in. in diameter at the open end, both the diameters being held to a 0.002-in. tolerance. The amount of material removed varies from $\frac{3}{4}$ to $\frac{1}{2}$ in. in thickness. For finishing, the piston is held by a mandrel inserted in the

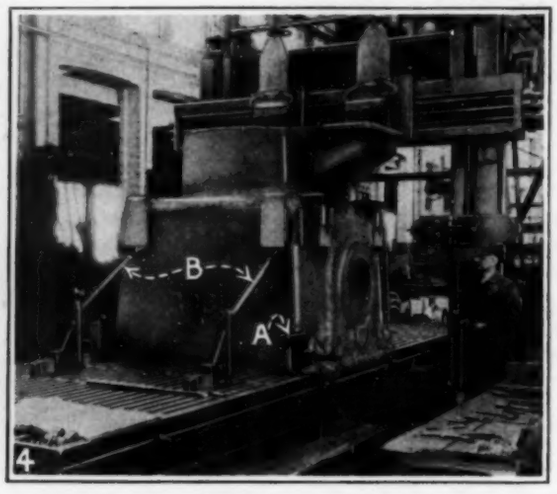


Fig. 3—Planing one of the bedplate units. Fig. 4—Machining top and sides of cylinders

AUTOMOTIVE PRODUCTION

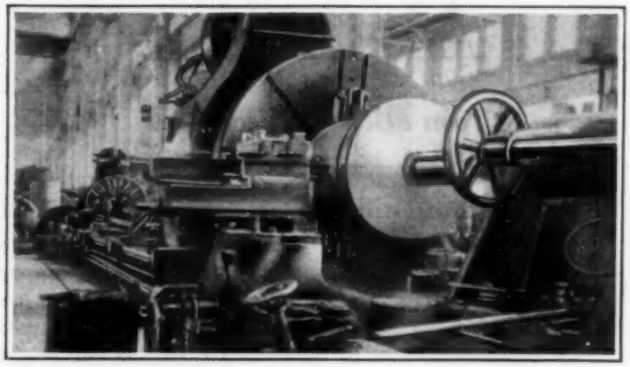


Fig. 5—Turning one of the compressor pistons

open end and a plug at the shaft end. There are five ring grooves machined in the larger diameter and five in the open end, $\frac{3}{8}$ and $\frac{7}{16}$ in. in width, respectively.

Machining Cylinder Heads

The method used for machining cylinder heads is shown in Fig. 6. Three pieces are positioned and clamped on the table so the surfaces *A* are in proper alignment. The work is located by the previously finished bottom surface which is faced on a boring mill. After the bosses are finished the work is turned so the next set of bosses *B* are in line for machining. The surfaces *C* are then machined, after which the faces *D* of the three pieces are likewise finished to size. Approximately $\frac{7}{16}$ in. stock is removed from the various surfaces. All the cylinder heads for a unit must be interchangeable with one another. The important sizes are held to limits of ±0.003 in. The work following this operation is drilled for the various holes, bored for scavenging parts, tested and inspected and fitted with the inner head and studs, making it ready for assembly with the cylinder. All the drilling and the boring is done with jigs and fixtures to make the parts interchangeable.

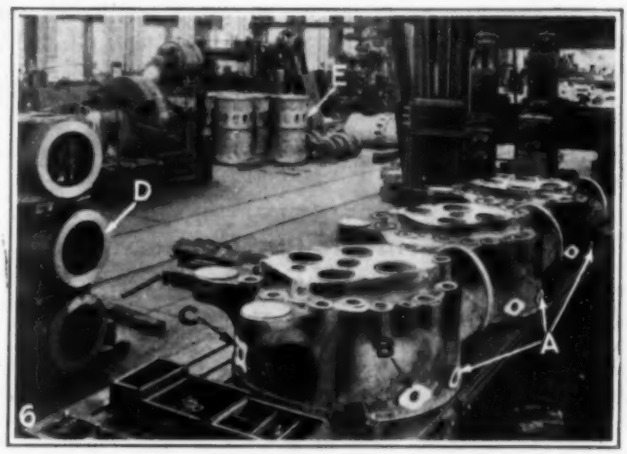


Fig. 6—Set-up used for machining cylinder heads

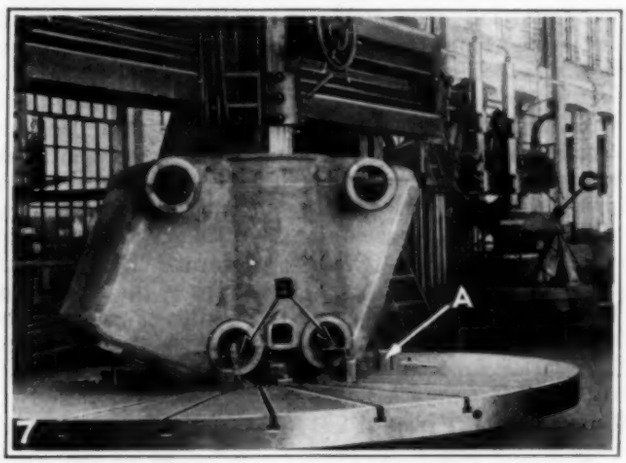


Fig. 7—Boring a scavenging cylinder

A number of the cylindrical parts are bored and faced on boring mills, the sequence of operations being somewhat similar. Fig. 7 shows the set-up for boring one of the scavenging cylinders. The work, made of cast iron, is centrally located by four adjustable locating blocks *A* and held by four clamps *B*, two of which are located on a side. One roughing and two finishing cuts are required for sizing the bore to a 0.004 in. tolerance, taking off $\frac{3}{8}$ to $\frac{1}{2}$ in. of metal. In the background at *C* is shown a step-up using a special fixture used for boring and facing one of the crank webs on a 10-ft. boring mill.

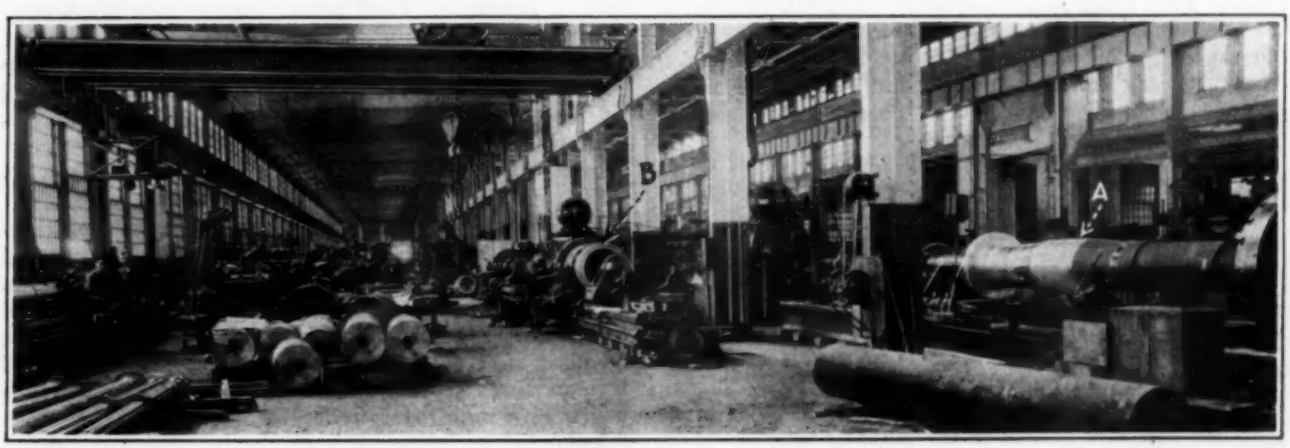


Fig. 8—Shaft-turning department

AUTOMOTIVE PRODUCTION

For the completion of a unit, a number of shafts of various sizes are required, most of which are handled in the shaft-turning department shown in Fig. 8. At A is shown the generator shaft set up on a 60-in. x 39 ft. 6-in. lathe. Extreme accuracy is maintained on the various diameters and shoulders, necessitating checking by special gages. A cylinder liner set up for turning and facing is shown at *B*, others being shown also at *E* in Fig. 6. A general idea of the machine tool layout for shaft work may be seen. Ample room is allowed for piling work, either finished or unfinished in the aisles. The company uses a number of grinding machines for finishing smaller shafts and other parts, such as crosshead bearings, all cams, cam rollers, all pins, and fuel and scavenging valves.

This installation of Diesel engines shows the trend toward the use of larger sizes of this type of power, and, judging from past advancement, it is probable that even larger sizes will be built in the future.

Improvements in Automotive Workmanship

By Frank C. Hudson

The interchange of ideas between various automotive shops is reflected in the many similar practices that are found in the different plants. Many of the ideas and methods that originated in the Ford plant found their way into other shops. On the other hand many refinements that were originally only thought possible on high-priced cars, are now to be found in plants building cars of the thousand dollar class.

New methods of grinding and lapping have made it possible for even very low-priced engines to have piston pins, crankshafts and cylinder bores that are far more accurate than those in the most expensive cars of a few years ago. Tolerances of two-tenths of a thousandth are not uncommon in piston pins today, on even some of the lower priced engines. And as piston pins receive the first, and most severe "wallop" after ignition this is a step toward motors of longer life.

There is, as might be expected, a conflict of both opinion and practice as to interchangeability in the extreme meaning of the term. Selective assembly has many advantages and is being used in many of the best shops. For, while it is possible to maintain tolerances that permit absolute interchangeability with very close allowances for oil film, etc., it is not necessary in order to secure easy running engines and cars. And many of those who have insisted on absolute interchangeability, have gone out of business.

Interchange of ideas and improved machine tools and machining methods have made it possible to secure high-grade workmanship at a very low labor cost. As a result it is almost impossible now to find an automobile of any grade, with really poor workmanship in the engine and chassis.

The result has been to increase the mileage-life of car appreciably and to decrease the need for replacement. Unless the builders can offset this by radical improvements in newer cars, there will be more of us who will run cars nearer to the point of wearing them out than we do at present.

Abstracts

from other publications

Vanadium and Other Steels

Chief Marine Counsellor Schulz, of Berlin, gives a review of the behavior of a number of alloys at ordinary and increased temperatures, and his discussion of alloys containing vanadium gives a full list of sources of information. It is of interest to note at the start that the German Government, in 1913, thought seriously of using gas or oil turbines in submarines. They were therefore looking for a bucket material capable of working at temperatures of 600 to 700 deg. C. In this connection, tests of elastic limit, ultimate strength, Brinell hardness and other qualities were carried out at ordinary and increased temperatures, and special appliances for this purpose were developed. Chrome-vanadium steel with 0.58 per cent vanadium appeared to be superior, but later an alloy steel containing somewhat less than 3 per cent nickel and somewhat less than 16 per cent chromium (Becker I and II) has been found to be even better. This has not prevented, however, the recognition of vanadium as a very valuable material both for deoxydizing and alloying purposes in cast iron as well as steel castings and steel forgings. It is now being used even in bridge design. The machining or casehardening properties are not hurt but an all around improvement is secured from 0.2 per cent vanadium or less. On the other hand it is stated that a chrome-vanadium steel (with 2.38 per cent chromium and 0.58 per cent vanadium) is comparatively sensitive to impact and that machine parts made of this material must show no sharp changes of form. The price of vanadium is still too high. Researches at the Bureau of Mines and also in Germany give promise of price reductions.—*Der Motorwagen*, Oct. 20, p. 629.

Ford's Irish Plant

Although relatively a very small part of the Ford organization, the Irish Free State plant provides abundant evidences of Ford principles and manufacturing policy. The Cork works is operated under the name of Henry Ford and Son, Ltd., and in addition to supplying the requirements of the Irish Free State in cars and tractors, it provides all the engines and rear-axle assemblies required by the Trafford Park Works. Henry Ford and Son, Ltd., is a separate and distinct organization from the Ford Motor Co. (England), Ltd.

The factory itself is of steel and concrete construction and is built on the one story plan. The covered area is about six acres but the site is about 130 acres. The foundry covers 94,000 sq.ft. with an additional charging floor of 16,000 sq.ft. The machine shop covers an area of 116,000 sq.ft. The average production of iron castings from the foundry is about 60 tons per day. Five hundred cylinder blocks are produced each 8 hours.—*The Automobile Engineer* (England), Nov., 1925, p. 406.

The Financial Responsibility of the Foreman

By J. Eigelberner

Profit is dependent on correct cost accounting—Accuracy is necessary for good records — How the foreman can insure accurate cost records

THE foreman has come to realize that he is responsible for the wise and economic use of materials, and that it is good foremanship to lead his men rather than to drive them, but while these two phases of the subject have been discussed frequently and at great length little has been said about the part that the foreman plays in the financial end of the business. The primary object of a business enterprise is to earn a profit which represents the difference between the price received for goods and the cost to produce them and to place them in the hands of the buyers. As a rule, no one invests money in an enterprise unless he is fairly sure of realizing a profit from his expenditure of time, money and effort. The chief expenses that are included in the cost of placing the product in the hands of the buyer consist of the factory cost, the selling expense and the administrative expense. The control, therefore, over these items of expense determines the rate of profit. The foreman, naturally, has no control over, or relationship to the selling and administrative expense, but he is intimately connected with the factory cost, which constitutes one of the big factors in the cost that it takes to turn out the product. Into the manufacture of any article there goes a certain amount of raw materials, labor, equipment and buildings, time and effort. To maintain the factory force at a high degree of efficiency, supervision is called for as well as clerical assistance and labor of various kinds that do not go directly into or cannot be applied directly against the product.

THOSE companies that have neglected to adopt a systematic and accurate cost accounting system, capable of dependability as a means of prophesying the true prices of their products, do an injury to themselves if the price that they hazard is too low and also an injury to their competitors who are entitled to fair profits. The foreman can play an important part in the accuracy and utility of original cost records. His own work will improve with the analysis.

All of these things, nevertheless, enter into the cost of producing goods, and there must be some orderly method for gathering and recording the information that shows the amount of time, effort and materials expended in manufacturing the goods. This collecting of information is the function of the cost department.

There was a time when but few manufacturing establishments really knew how much their costs were. Some years ago the Federal Trade Commission showed that less than 10 per cent of the manufacturing establishments of the country had a reliable cost system, and this situation, while no doubt greatly improved since then, is, nevertheless, not what it should be, by any means. Thousands of concerns are still in the dark regarding their costs.

A great deal is being said about the losses growing out of unrestrained competition. Concerns that have an accurate system for determining their manufacturing costs constantly experience the losing of contracts or sales to other concerns who agree to furnish the goods in question at a lower price. Sometimes the variation between prices for a given article will be as much as 200 per cent. I have in mind a case where the top bid on some castings was nearly three times the lowest bid. When in competition, some concerns know their costs and others only guess at them, the latter invariably take a great deal of their business at a loss. It is only a question of time before they either change their methods or go out of business if they take on very much of such work. In the meantime they have done two great injuries to industry. They have damaged themselves by making it impossible to earn a profit to which they are entitled and they have hurt other concerns in the industry who, without their interference, would have been able to provide the goods at a reasonable rate of profit but lose the business to guesswork figures.

Systematic cost keeping serves industry in three ways. First, it makes possible the determination of accurate prices, for, in the last analysis, price is based on manufacturing cost, to which is added the necessary administrative selling expense that is required to get the product to the purchaser. When manufacturing costs are not accurately known, prices become guesses either too high or too low. When they are too high, the demand is cut down accordingly or competition is invited to come into the field to sell at a lower price. When the prices are too low, what business that is done is handled at a loss. Either condition ends in disaster and could be remedied by cost keeping.

Second, it furnishes a means for measuring manufacturing efficiency. Cost figures are collected, recorded

An address delivered before the convention of the Ohio State Federation of Foremen's Clubs, Dayton, Ohio, May 12, 1925.

and summarized in an orderly manner so as to show the efficiency of various divisions of manufacture. Through periodical reports of a comparative character, the managing executives are informed as to the way in which the factory is running. These reports show the results of past action clearly and indisputably.

Third, it provides a means for planning improvements. While it is interesting to know what it has cost to produce in the past, the knowledge is valuable only if the figures and results are analyzed so that plans may be developed for getting better results in the future.

Elimination of waste is one of the most valuable benefits that can be derived from the utilization of cost information. While the figures showing the waste of time, money, material and energy will, in themselves, accomplish nothing, they show whether or not some kind of action must be taken to reduce the cost of this waste and where the improvement is necessary. They serve also as standards that represent targets at which the manufacturing department may aim in the future. The cost system, therefore, represents the microscope of manufacture. It reveals the otherwise hidden germs of failure that feed and fatten on the profits and destroy the vitality of the business.

The stress placed on the subject of cost keeping has been made to show, because of its importance, the value of accurate cost-keeping records from which to ascertain the cost. It has been made to convince the foreman of the important part he has to play in determining true manufacturing costs and his responsibility in this connection.

Value of Basic Information

No matter how elaborate may be the methods developed for the gathering and compilation of cost information, no matter how completely may be the reports and summaries showing the efficiency with which labor, material and machinery have been used, the results of all this work will be valueless if the basic information upon which these reports and summaries are built is incorrect, incomplete or inadequate.

The function of cost keeping is a secondary one in this respect and exists for the purpose of recording the information contained in time tickets, material requisitions, inspection tickets, repair tickets and many other types of orders, requisitions and so on, and classifies the information included on these tickets to produce the final cost.

Upon the accuracy, completeness and adequacy of these original records depend the accuracy of manufacturing costs. Upon the accuracy of manufacturing costs depends the profits and upon those profits depends the livelihood of the foreman. The great responsibility of the foreman lies in assuring that the records that he turns over to the cost department are true statements of what has been done.

Accuracy demands that when materials are used, the exact amount will be recorded charged against the job to which they were applied. Accuracy demands that the exact amount of time expended on each job will be recorded. Accuracy demands that when materials are returned to stock, the job will be credited with their return.

Whenever original records are inaccurate it is usually traceable to carelessness or indifference on the part of the workers. But that carelessness or indifference is usually a result of the foreman's failure to properly explain to the workers the necessity for accuracy in furnishing information. When the workmen are properly informed and realize the reason for this pencil work, they look at it from an entirely different standpoint and better results are secured.

Completeness requires that time and material tickets include all the information necessary for proper cost determination. When tickets are filled out incompletely a subsequent check-up is necessary at a time when the details are no longer fresh in the mind. The responsible foreman should carefully instruct the workers so that complete records are furnished and so make unnecessary this constant checking back and forgetting of important details. Legibility of writing is an important consideration. Carefulness in making carbon copies is another. Many forms call for entries in certain spaces, and therefore carbon copies must line up exactly so that entries will not appear in spaces where they are not intended.

The diligence of the foreman will greatly simplify the work of cost keeping, make possible accurate manufacturing costs and enable the executives to determine correct prices for the product, to properly view the results of past operations and to plan for the future.

Function of Cost Accounting

It is the function of the cost department to issue periodically certain reports or summaries showing the results of manufacturing operations. It is the custom of some of the most progressive companies to furnish the foreman with regular statements showing the efficiency of his department as a whole, the output of individuals, the bonus earned, idle time and other information of a similar nature for the purpose of showing the foreman how well he is doing his job as compared with certain standards.

Many foremen, unfortunately, do not recognize this second responsibility to the management, in not utilizing to the fullest extent these reports. If the managing executives rely upon this information to plan for the future business, the foreman, entrusted with the operation of a part of the business, can well afford to utilize these reports in the same way. It is quite true that some foremen have their noses so close to the grindstone of production that they cannot see the value of these reports. In other cases, the cost department furnishes the reports in such a shape that the foreman is not able to use them to advantage.

Old Data Are Useless

The average foreman is shrewd and can be shown the value of watching certain elements when by so doing he can make his work easier or get more effective results. The chief difficulty is that cost information, collected at great expense, often comes to him so late that it can not be used as a means of control but is only of historical interest. In that case, it is not to be wondered at that the foreman looks on many of these cost reports with a great deal of skepticism.

The right kind of a cost system, however, wil show the foreman specific information on the operation of his department, which will be pertinent and usable, furnished in terms reflecting the true status of affairs, requiring no translation on the part of the foreman before being utilized. It should be prompt, not in a week or ten days, but immediately following the event. It should be accurate, correctly classifying items, such classifications to be based upon scientific analysis and not guesswork. It should be comparable. Everything

in life is relative. It is only by comparing and contrasting conditions with those of a similar character that one is able to detect inefficiencies.

Assuming, then, that the records are forthcoming, the foreman owes a responsibility to his employers, because through study of the reports he is enabled to constantly improve the efficiency of operation, resulting in lower costs, increased output and decreased expenses; and he owes it to himself because by so doing he increases his value to the organization, thus putting himself in line for bigger and broader opportunities.

Cost System Requisites

How can the foreman best accomplish his twofold responsibility? In the first place, he ought to make the detailed records that leave his department of such a character that they furnish the proper information and to be sure that all clerks and workmen making entries of any kind on such records realize the necessity for accuracy.

In the second place, he should make full use of data coming to him from the cost department showing the efficiency of operation. Depending upon the type of manufacture, these records will be of various kinds, but in all cases their function is to show trends of production cost and comparative data from week-to-week by machine, operation and workman. In all cases where such cost reports are furnished foremen, the foremen who stand highest in efficiency are those who make the fullest use of the records.

In the third place, he should periodically check all types of records with a view to improvement of the forms, both those he has a part in making and the ones he uses. For each form, record or report that is prepared by his department or that comes to him he should inquire as to the purpose of the record, its necessity and its adequacy.

In checking the form for adequacy, the following check list has been found practical:

Does the form include all the items of information called for by its purpose?

Is the sequence of the information such as to give the most important elements the most desirable position or such as to arrange all elements for ease of recording or consultation?

Is the proper amount of space allowed for the entry of necessary information?

Does the form duplicate in whole or in part any information furnished through other means?

Is the size of the form such as to best serve its purpose and at the same time be most economical from the standpoint of purchasing?

Is the grade of paper used in the form able to withstand usage, to clearly record impressions and to insure permanency of the record?

Considerable attention has been given, during the past few years, to the simplification of products as to types and sizes. Almost any large manufacturing establishment can apply simplification to its forms by a little time spent in analysis of the same nature as that for simplification of products. In one concern of which I have had personal knowledge, such an audit and analysis of the records and forms made possible the elimination of over 200 forms within a period of six weeks and a payroll saving of over $300 a week. The foreman will be helpful himself if he can simplify the forms and in so doing will accomplish a part of his twofold responsibility to his firm.

That Odd-Sized Bushing

By H. W. Myrick

"Here, Jim, here's an awful hurry-up job. This fixture has a ½-in. drill bushing in it that is so badly worn that the drilled holes in the work won't pass inspection and it is holding up production. Drop that job you're on and put in a new bushing as quick as——." The foreman handed Jim the fixture and a plug gage to which the new bushing was to be fitted, and walked away, leaving Jim to his own devices.

The first thing Jim did was to measure the plug gage, which he found to be 0.1225 in. instead of the one-eighth that the foreman had said. He then removed the worn bushing and applied his mikes to the outside diameter, finding the body to be ⅜ in. with a ⅞-in. flange. Next he went to the toolcrib and called for all the ½-in. reamers in stock. The only one within gunshot of his requirements was too large, measuring in fact 0.1237 in. This was plenty large enough to ruin the job, but as it was fairly sharp, Jim took it to his bench.

Having selected a reamer drill, a ⅛-in. draw-in collet and a piece of ⅛-in. drill rod, he went to work in the bench lathe. He drilled the through hole and deliberately reamed it with the too-large reamer. He then turned the outside diameter of the body, allowing 0.015 in. for grinding, cut off the bushing, rounded and polished the flange end of the hole, rattled the gage around in the hole, and examined the surface left by the reamer. Here he got his first jolt.

"Durn it!" he said, "Why'n'ell can't that crib-tender keep his tools sharp?" He then poked around in his kit until he found a suitable lap with which he lapped the bore of the bushing smooth. Next he took a piece of round stock about a foot long that miked to 0.118 in., drilled a small cross-hole close to one end and put a pin through it so that when the bushing was slipped over the rod it would not drop off the lower end.

He put the plug gage in his pocket, went to the toolroom fire and hardened the bushing, dipping it flange end down as it hung on the rod. Taking the cold bushing off the rod he tried the plug gage and found that it still rattled around in the hole.

Second Attempt Wins

He put the bushing back on the rod, brought it very gingerly over the fire, heated it slowly up to hardening temperature and again dipped it in the quenching medium. He then tried the gage again and found that though it would still go in the hole the rattle had disappeared.

Jim then repeated his hardening tactics, being even more careful in heating and quenching the bushing. This time he found upon inspection that the very end of the plug would just enter the hole. He tested the bushing with a file and found it to be satisfactorily hard. After lapping the hole to a sliding fit on the plug, as he had been instructed, Jim put the bushing on an arbor and ground the outside diameter to size, drove the finished piece into the fixture, gave it a few twists with the lap until the fit of the plug suited him, and turned the job over to the inspector who passed it promptly.

Jim then went back to his interrupted job and forgot all about the odd-sized bushing. It was all in the day's work.

What Is Your Export Ratio?

From *Commerce Reports*

WHY should manufacturers of air compressors have better export business than manufacturers of concrete mixers? At first thought one might expect the advantage to lie with the concrete-mixer manufacturer because of the nature of the work and the surroundings under which his product is commonly employed.

Why should the percentage of export orders secured by a manufacturer of excavating machinery be greater than that of a manufacturer of metal-working machinery? American excavating machinery usually represents a very high state of engineering development. These units are frequently very costly and one might expect that the labor conditions in most foreign countries would make it unnecessary to employ machinery of this character, while machine tools are necessary for a great number of manufacturing operations and would seem to be in more general demand.

A great many similar questions naturally arise in considering the accompanying chart, which indicates the total volume of production and the percentage exported applying to certain classes of American industrial machinery, and it is interesting to speculate whether the situation illustrated by this diagram is the result of fundamental conditions or merely expresses the comparative business ability and sales effort manifested by the management of these different producers of machinery.

Conditions have now reached a point where American machinery manufacturers should give very careful attention to their export business. Unusual opportunities are to be found in these foreign fields because Germany is gradually losing its position as a competitor. Before the war Germany furnished perhaps 45 per cent of the machinery that went into international trade and since the close of the war there have been times when the depreciated condition of the mark gave German manufacturers a peculiar advantage in this trade. That situation has now passed and in great measure German prices already exceed world-market levels. Experience shows that deliveries from German manufacturers are slow and frequently uncertain, and in a great many ways it is difficult for foreign dealers to buy in Germany on a basis that is at all satisfactory. Trade that formerly went to Germany will more and more fall into the hands of others.

American engineering and American machinery are distinguished in the world's markets for their superiority. Americans are noted for their engineering achievements, but, because of this superiority, American machinery is usually higher in price than similar equipment secured from foreign sources and must be marketed on a quality rather than a price basis. In other words, this trade, which formerly went to Germany, will now pass to British manufacturers unless American products are supported by constructive sales effort of such character as to demonstrate that American equipment is worth the price asked, and more. Manufacturers should now organize their sales effort along such lines as will accomplish this result.

Export business is becoming more and more essential to the prosperity of the individual manufacturer. The accompanying chart shows that it is of great importance to manufacturers of mining machinery. The difference between a satisfactory or an unsatisfactory export ratio can easily represent the difference between profit and loss on the year's balance sheet. Manufacturers have a very definite opportunity to improve their export ratio, and it remains for them to make the sales effort necessary to secure these results. The present international situation provides an unusual opportunity.

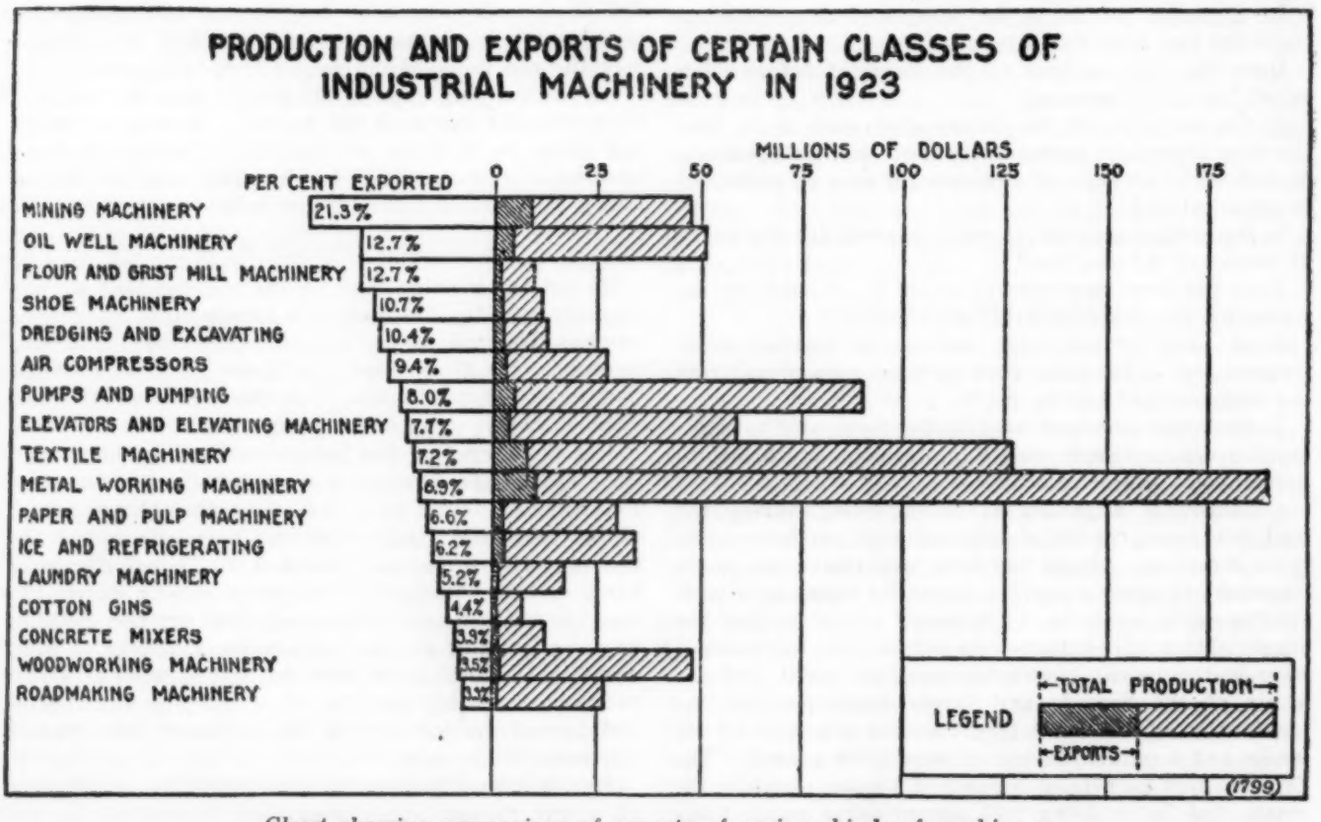
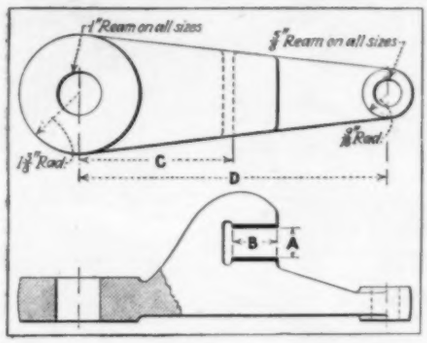


Chart showing comparison of exports of various kinds of machinery

Conditions of the Problem



Design a fixture to hold the work while the metal indicated by the heavy lines at the dimensions A and B is being removed. Seven sizes as tabulated are to be considered. The fixture may be universal to accommodate all sizes or individual fixtures may be designed to take one or more sizes as may seem desirable. Economy in cost and highest operating efficiency are desired.

Material—cast iron.

Depth of cut—approximately $\frac{1}{16}$ in.

Total quantity — 200,000 yearly (in lots of 5,000 each).

Both ends have been straddle milled and reamed.

Contestants to select method, type of machine tool, small tools and to design fixture. Feeds, speeds, cutting time and floor-to-floor time must be given.

A	B	C	D
$\frac{7}{8}$	$\frac{3}{4}$	3	6
$\frac{7}{8}$	$\frac{3}{4}$	$3\frac{1}{4}$	6
$\frac{7}{8}$	$\frac{3}{4}$	$3\frac{7}{16}$	$7\frac{1}{4}$
$\frac{7}{8}$	1	$3\frac{3}{4}$	$7\frac{1}{4}$
$\frac{7}{8}$	1	4	$7\frac{1}{4}$
$\frac{7}{8}$	1	$4\frac{1}{4}$	8
$\frac{7}{8}$	1	$4\frac{1}{4}$	9

Another Winning Solution to the Second Prize Problem

THE judges for the second prize problem, which was originally published on page 632, Vol. 62, of the *American Machinist* have found that they overlooked the merits of one of the many solutions offered in the contest and failed to award the author a prize or to publish the solution with the other winners that were announced on page 663, Vol. 63, of the *American Machinist*.

The judges offer their apologies and hereby announce the award of a $50 prize to Ben C. Karr, Cincinnati, Ohio. Mr. Karr's layouts and the outline of his solution follow:

For performing the operation of machining the two surfaces on the seven sizes of the part shown in Fig. 1 my solution is divided into its component parts.

Method—Automatic station milling.

Machine—Oesterlein "Ohio" tilted rotary, 40-inch.

Fixture—One capable of adjustment to receive all sizes of the parts and to carry these parts in groups of two at three points or one similarly built but mounting three parts at each station. The first named fixture would cost $250 and the other would involve an expenditure of $375 complete with clamps, locating pins and all parts ready to mount on the machine.

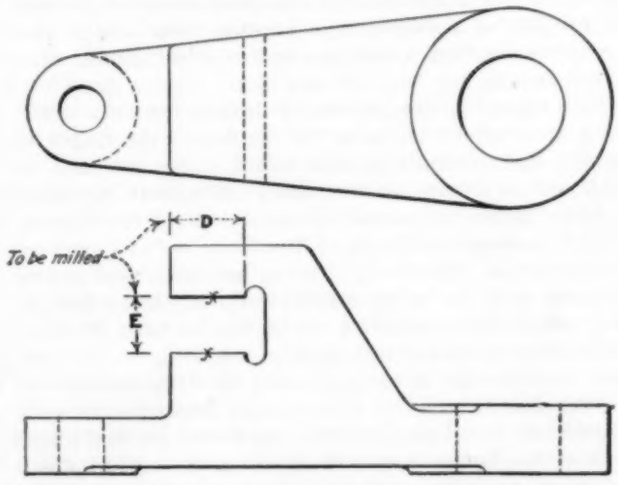


Fig. 1—The part to be machined

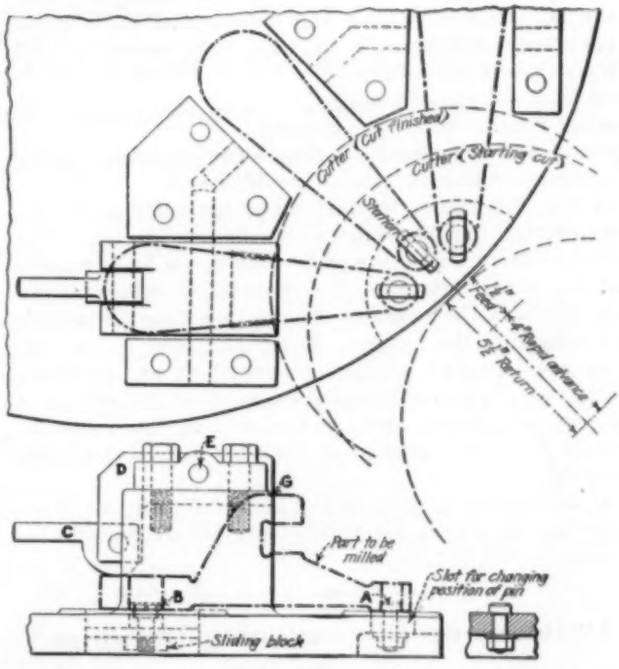


Fig. 2—Layout of the fixture at one of the stations

A diagrammatic layout of one of the stations on the latter fixture is shown in Fig. 2 to indicate the grouping, the cutter travel and the method of holding the work. The parts are located on the pins *A* and *B*. These locating pins are adjustable so as to receive all seven sizes of parts. The cam lever *C* clamps the part. This cam lever is carried in the clamp *D* that is pivoted on the pin *E*. The front of the clamp *D* is shaped out to support the work at *G*, just back of the cut. The

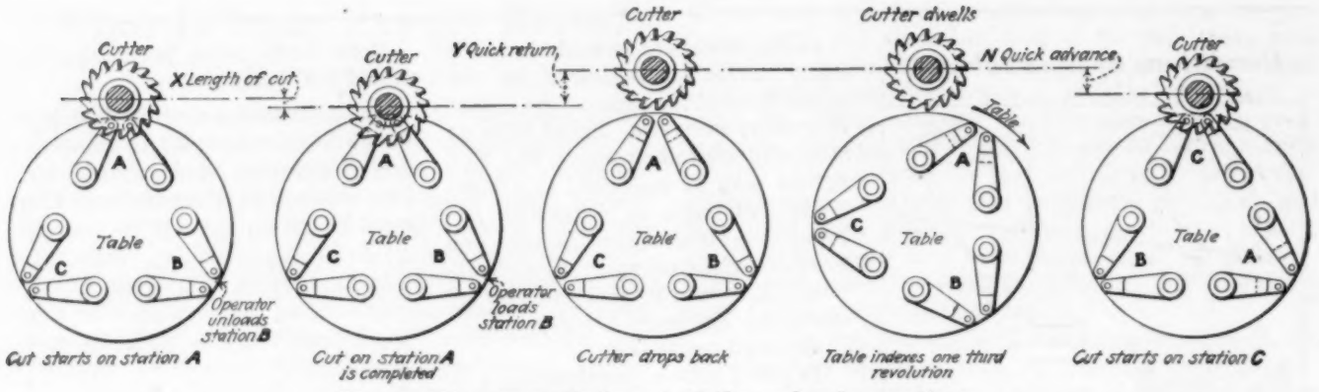


Fig. 3—Diagrammatic layout of the cycle of operations

clamp takes part of the thrust of the cut away from the locating pins and also prevents chatter. The cutter advances rapidly 4 in., then slows down to the 8-in.-per-min. feed rate for a distance of 1½ in. It then drops back rapidly 5½ in. as the table indexes. The feed travel of 1½ in. mills three parts, which accounts for the high production possibilities.

Cutter—One 11x⅜-in. side mill made of high-speed steel.

Production—Using the three-station fixture with two parts per station a production of 320 pieces per hour can be attained. Using the fixture that holds three parts per station will increase this figure to 432 pieces per hour.

Feed Rate—8 in. per minute.

Cutting Speed—80 ft. per minute.

Cutting and floor-to-floor time—The machine being automatic these two times are identical.

In Fig. 3 is shown the method of operation using the three-station fixture with two parts per station. The cutter feeds into the two parts then drops back rapidly and the table indexes. The machine functions automatically and the operator devotes his time to loading and unloading the fixture. Every 22½ seconds the machine goes through a cycle of operations and produces two parts. To produce a total quantity of 200,000 parts requires 625 hours and, as the fixture costs approximately $250, this method is the most practical for the quantity.

At an increase of $125 in the cost of the fixture, three parts can be milled per station and the production increased to 432 per hour.

Opinions on Dimensioning Drawings —Discussion

By Major T. C. Fraser

Superintendent, Gun and Shell Factory, Cossipore, India

I confess to a sense of disappointment with the opinions on the dimensioning of drawings published on page 259 Vol. 63 of the *American Machinist*. I had hoped more for authoritative opinions from the big engineering firms over the signatures of senior members of their staffs.

The opinions published, while containing many points which will require consideration when formulating a complete proposal, suffer from being too individualistic.

They also show, in general though not entirely, a lack of appreciation of two main points essential to the consideration of the subject.

The first is that the discussion must be based primarily on interchangeable manufacture in its fullest sense where each piece of metal must be made and gauged entirely to its own drawing and must mate without the further use of any tool or even of selective fitting. The application of the principles and of any system thus arrived at can, subsequently, be modified to suit the individual circumstance as dictated by required accuracy, quantity or expense.

Subsidiary to this there is also the point that many ordnance stores, especially gun breech components must be interchangeable to the fullest extent not only in the gun but also, though to a lesser degree of accuracy, in the fitted spaces for spare parts in vehicles on in pack transport. This limits tolerances on surfaces which, as far as the mechanism is concerned, are nonfunctioning.

The second point is that design must not be confused with the method of depicting the result of design.

Design includes the amount of manufacturing tolerance and of functioning clearance or nonfunctioning interference. The detail method of showing these on the drawing is a separate consideration.

The former is largely catered for in various publications by the American Standards Bureau and the British Engineering Standards Association. A committee of the latter is now discussing a proposed report on draughtsman's conventions.

In fully interchangeable manufacture the design should include a tolerance on every dimension, a fit for every pair of mating surfaces care that if possible the full use of a tolerance in one place does not prevent the full use of a tolerance in another place and if this is not possible then a warning to this effect should show on the design.

With regard to the placing of dimensions on a drawing I am content to leave the matter in the hands of the B.E.S.A. committee but would point out that in the layout of dimension and centre lines great care must be taken to prevent undue accumulation of tolerances.

To the advocate of vulgar fractions for any purpose the answer is "Educate." France has long used metric decimals and for all accurate work in Great Britain decimals of an inch have been in use for over 20 years and neither would revert at any price. I would, however, remark that a decimal point is often invisible in a blurred blue print so it is always advisable to write 0.5 and not .5 and also that the number of decimal places to be given should vary with the accuracy 0.250 indicating more accurate work than 0.25 even if a tolerance is stated.

Fig. 12—Storage for the double-acting dies

Press Tools on a Production Basis

By W. E. Irish
Associate Editor, *American Machinist*

Facilities for storing and handling the press tools—Method for identification—Control of small hand-tools through local cribs from a central station—Hand-tool construction, maintenance and salvage

MANUFACTURE and maintenance of press tools at the Edward G. Budd Manufacturing Co. in Philadelphia have been described in previous articles. To make the discussion complete, this article deals with the storage of the press tools, their handling to and from the presses and the methods of control for small tools which are used in building the dies and in the direct production on the pressed-steel automobile bodies.

There are several storages at different points in the plant located conveniently for the departments they are intended to serve. Their extent, and the number of tools handled, are indicated by the general views, Figs. 12 and 13, taken of two of them. To the left, in Fig. 12, is shown one of several rows of racks for holding some of the smaller tools. Both bays are served by cranes of sufficient capacity to handle the heaviest tools readily.

The tools are brought from the presses in the main building by crane and are landed on trucks for transport to within the range of the storage crane, or are pulled directly on trucks from the presses by means of the fleet of tractors which serve the various departments.

In Fig. 13, this intermediate transfer has been made unnecessary by taking advantage of the building arrangement and the non-interference of the storage and production cranes. The storage-crane tracks are extended out over the production floor far enough to make a direct transfer from one crane to the other.

The floor level of this storage is considerably below the elevation of the main floor, earning for it the name of "die-pit." Here, also, are stored the templets for the blanking tools and a good number of "first-hits" on certain of the forming tools on which records were desired.

The die racks, partly visible in Fig. 12, are illustrated to better advantage in Fig. 14. They are of interest from the standpoint of construction and arrangement to facilitate tool handling. They are constructed of channel uprights and angles, floored with wood and set in pairs. An angle on the outside of each pair matches a similar one on the next set, to form a track for a small transfer platform, one of which is provided for each shelf. These platforms are constructed to bring their tops flush with the top shelf. They are further provided with rollers to make their movement easy along the length of the racks.

Tool Handling Facilities

The tools are landed on the transfer platform from the crane and can then be pushed on rollers into their places in the rack.

In Fig. 15, is shown a tool which has come by truck from one of the departments or from the machine shop and is being placed under one of the die-pit cranes. This photograph illustrates to advantage the lift-truck platform construction used for this class of work. A view is given of one of the lift trucks in Fig. 16, which are used in connection with the platform.

The company has designed and constructed a number of substantial, adjustable-platform trucks which are used, as illustrated in Fig. 17, for placing, or removing tools from the presses. The construction is of angles and I-beams and four elevating screws carrying an adjustable platform of I-beams. The wheels are set so the

This is the third and concluding article on equipment organization, and procedure in manufacturing press tools on a large scale.

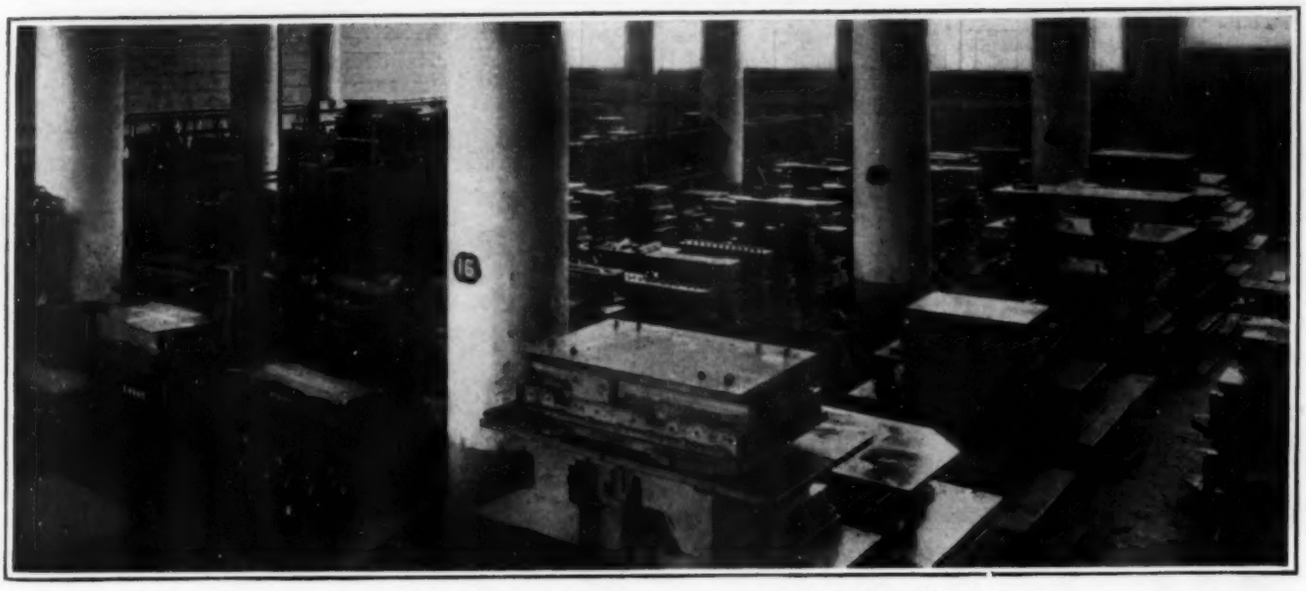


Fig. 13—Depressed storage, known as the "die-pit"

assembly, even when loaded, can be swung readily. The four small wheels are attached with their centers high enough to allow the load to be balanced on the main wheels at the center.

Wormwheels on each of the screws connect through worms to an extended shaft which is used to change the elevation of the platform to suit a given press-bed height.

Provision is made in the floor in front and behind the presses for attaching a snatch block, and by means of the lift hook on the crane, to move the released tool in either direction.

A novel custom, and one that renders material assistance to the control of the tools, is followed by painting the complete set for each customer, as well as the templets, a distinctive color. To understand the true advantage, it is only necessary to walk through the production department or to stand in one of the storages and see how readily sets of colors can be spotted.

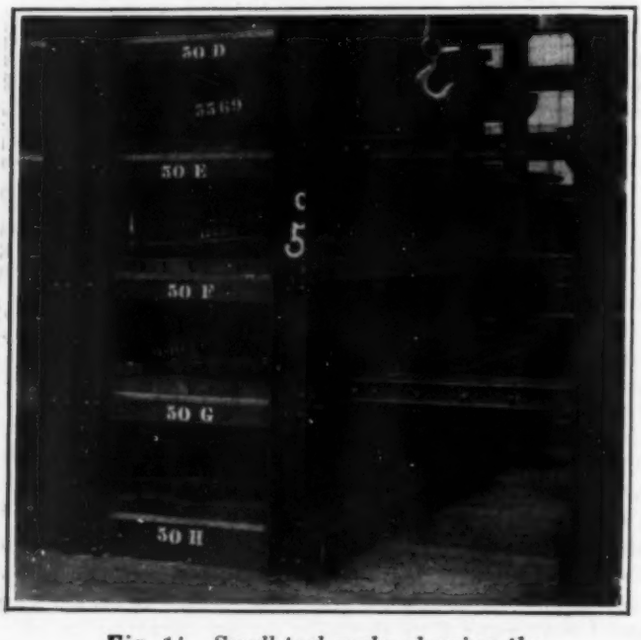


Fig. 14—Small-tool racks showing the transfer platforms

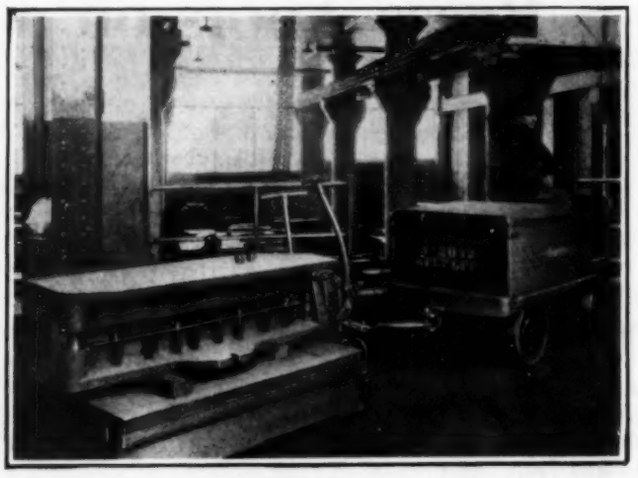


Fig. 15—A tool en route to the die-pit

The question was put to the management if this custom might not lead to embarrassing situations with some customer who was in a particular hurry for his work and had come to the plant to see what progress was being made.

The answer was significant and to the effect that the customer was assisted by being better able to see that his tools were at work as the promise date for delivery approached.

To handle the many small tools, drills, reamers, files, grinding wheels, hammers, and in fact all of such materials as will be found in the average toolcrib, there is a separate organization that functions with two points in view.

The first point is to supply correct tools in good condition to the men with the minimum of effort on their part and to replace worn ones with others in good condition so a maximum of useful work may be done by each man. The second point is to control the inventories and to conduct a campaign of maintenance and salvage that will result in controlling the costs of a division that can become exceedingly wasteful.

The foreman in charge is responsible for the conduct of 14 local cribs distributed at advantageous points in the production departments and a main toolroom where the central stores are kept, the clerical work and the

maintenance and salvage work conducted. In Fig. 18 is a view in one of the local cribs.

At the start, each of the local cribs was stocked with the supplies needed in the department which it serves, an inventory of this stock being charged out on the department's books kept in the toolroom office. This inventory then represents the stock-in-trade of that particular crib, value for which was owed to the central stores. A duplicate set of cards was furnished to the crib attendant to keep his own check.

In place of the usual brass checks, a supply of small cardboard tags is furnished each crib, as shown in Fig. 19. These tags bear the floor number of each crib, as L-5 on the ones shown.

Procedure in Supplying Small Tools

As a man needs a tool, he comes to the crib in his department and shows his number in order to have his needs filled. Upon delivery of the tool, one of the tags is made out by the attendant and posted against that workman's number on the check boards in the crib. These boards can be seen in Fig. 18, conveniently located on the slide rack in the center of the crib. Upon return of the tool in good condition, the tag is removed from the rack and destroyed.

On the other hand, should the tool be broken or worn out, the workman secures a requisition, as shown in Fig. 20, from the foreman. Upon presentation of this requisition and the broken parts of the tool, the tag charging him is removed and destroyed. This clears the workman and charges his department.

The attendant puts the broken or wornout parts of all returned tools in a steel tote-box and places the requisition in a pocket provided in a corner of the box, issuing new replace tools as required from his stores.

The tote-boxes are gathered up twice a day and taken to the toolroom, where they are lined up on a bench, as shown in Fig. 21. Here another attendant goes over the contents of each box and replaces all of the items with tools and supplies which are either new or reconditioned, a procedure which constantly maintains the inventory in each local crib.

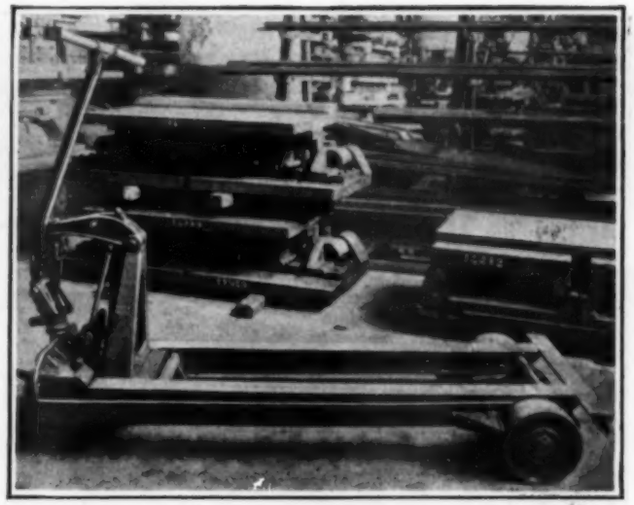


Fig. 16—One of the lift trucks

As he makes this replacement, he sorts out the returned items into those fit for repair and those which have no further value. Requisitions representing the items which can be salvaged are returned with the box to the crib. Those representing items he has scrapped are sent through to be marked off the inventory in the main stores and then to the accounting department for charge against the department from whence they came. The requisitions, sent back to the local crib, are returned to the foreman issuing them, and he is at liberty to destroy them.

By this method, each department is charged only with the material which it actually uses.

The possibility of a man, in one department, going to another to secure supplies, and thus confusing the records, is obviated by the system of man numbers which are distinctive for each department. Each crib attendant is instructed to issue to only those to whom he is local.

The system has a number of advantages:

The cribs are located to minimize the loss of time.

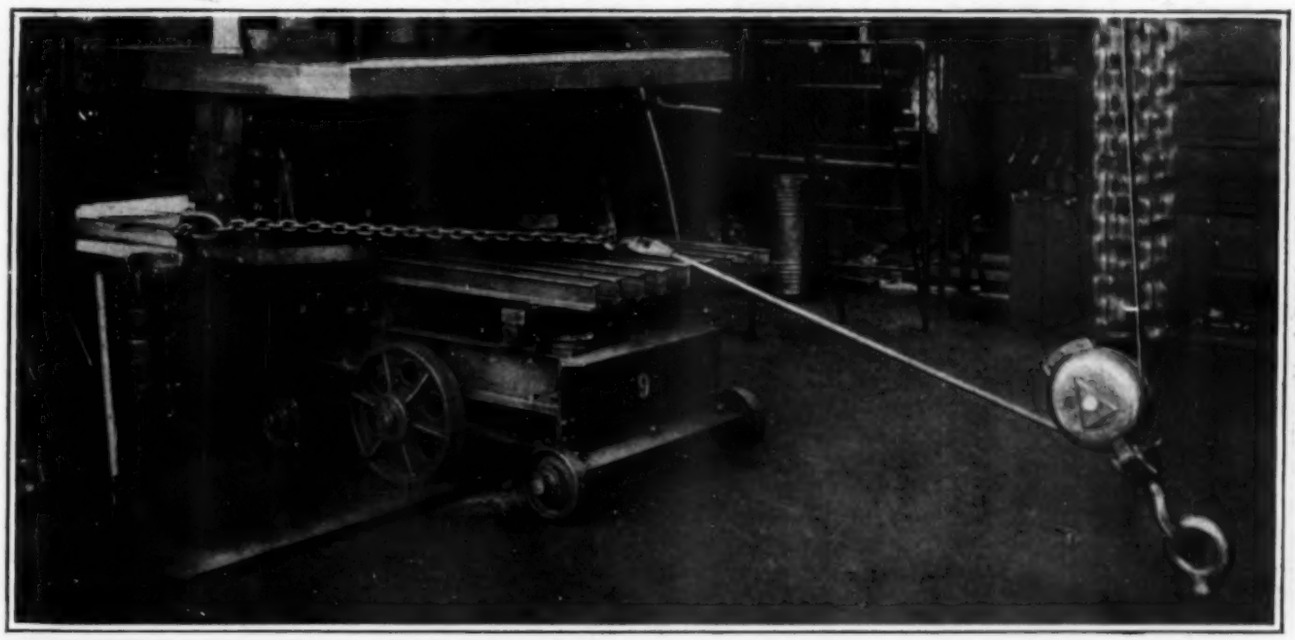


Fig. 17—Removing a tool from a press

Fig. 18—The interior of one of the 14 local toolcribs

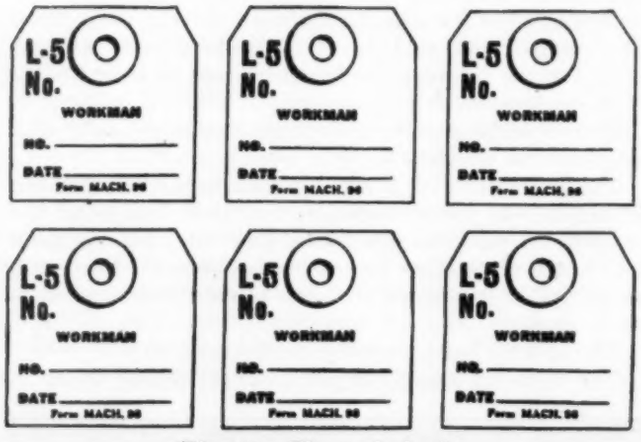


Fig. 19—The tool checks

Tools are at hand and obtainable with a minimum of red tape, and yet the responsibility for use and replacement is squarely on the production foremen.

Items that can be salvaged are returned in order to receive credit on the original charge-out, thus making them available and not subject to search as is the case in many plants.

There is no reason to work with any tool that is not in first-class condition.

Inventories are strictly controllable and each department is charged only as it actually uses up a given tool or supply.

The form of tag used cannot be duplicated easily, and the requisition is designed so it can be machine-sorted and counted at a minimum of clerical effort.

This description shows how the routine work is carried forward, and can be made complete by saying that

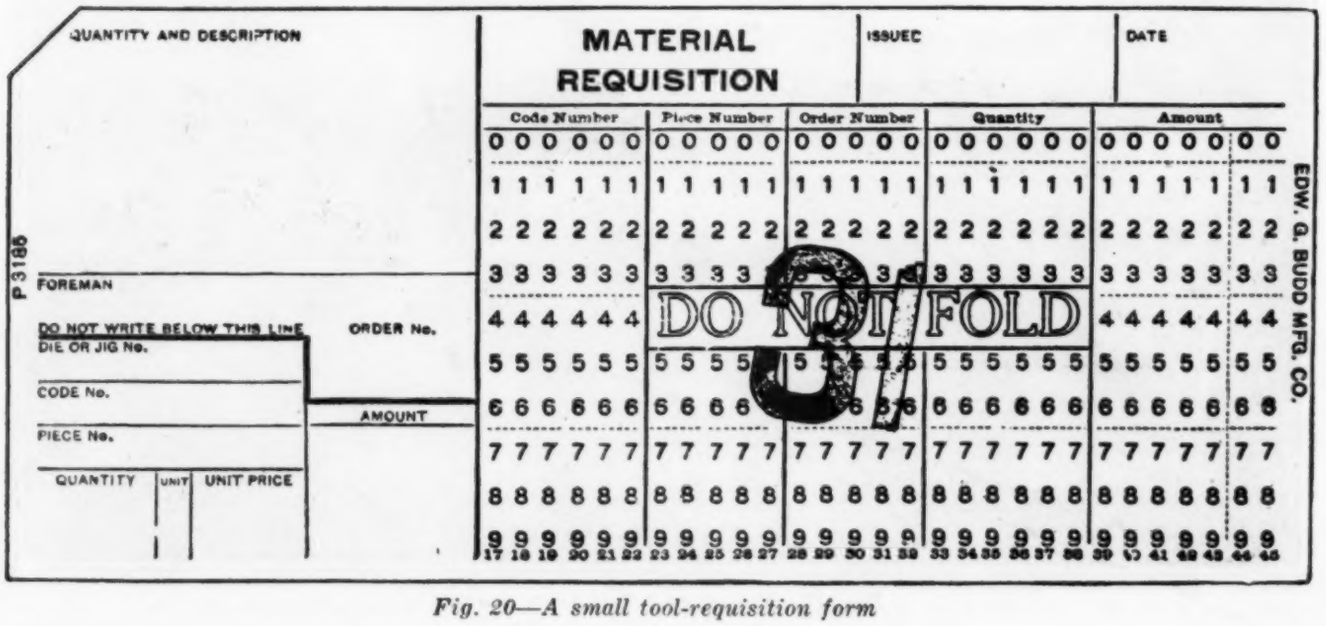


Fig. 20—A small tool-requisition form

as the cards in the main stores show set minimums based on the scheduled business, requisitions are placed at the approval of the toolroom foreman for purchase through the purchasing department.

Were this department's activities to stop here, it would have effected economies to more than justify its existence. In reality, it goes a good deal farther.

There is a constant search conducted for better tools, and methods that will improve conditions, and a considerable force of men are kept at work in the well-equipped toolroom making special new tools on order for jobs to come and for replacing small-tool supplies. In addition, there is a force constantly kept busy salvaging the tools and supplies returned from the cribs. An idea of the magnitude of this work can be gained from the statement that one man is kept constantly busy repairing goggles. Another spends full time resharpening drills, all of which work is done at this one point for the entire plant. There are numerous others doing similar single jobs to keep the needs of production supplied economically.

An Example of Small-Tool Salvage

Many schemes have been worked out in the program to make the most of each tool dollar. The salvage of the thousands of small drills below ¼ in. is as good an example as any. These drills are used in as severe a service as a drill can possibly be subjected to, that of hand drilling and reaming with electric and air-driven tools in the body-assembly line.

A full-length drill in such service, even with the greatest of care, cannot be expected to last any length of time, and did not until the following plan was devised and installed:

Straight machine-steel sockets, to fit in the drill chucks were made all of the same outside diameter, approximately ½ in. and about 6 in. in length. One set was drilled to take straight-shank drills when new and allow them to protrude from the end approximately one inch. New drills were then sweated into the shanks and delivered to the cribs. By leaving only this inch of unsupported length, they stand up much longer without breaking, and, in fact, the majority can become dull and be sharpened a number of times before they are too short to penetrate the required distance in the work.

When this occurs, they are removed from the new drill shank by simply heating them until the solder melts. They are then replaced in a second set of shanks, drilled out approximately one inch less deep and put back into service once more.

This process is repeated, using as many sets of shanks as there are inches of cutting flutes on the drill, less one. There is sufficient of this work to keep one, and sometimes two men, busy sweating new drills to shanks and changing shanks on old ones.

Press tools are handled on a production basis by the company. Small tools are on the same basis. The advantages to be gained are obvious, and require no further comment.

More Service from Drills—Discussion

By A. J. Karlson

The answer of the question, concerning what can be done to get more service per drill, on page 670, Vol. 63 of the *American Machinist*, is a good one, as I have used it. The only thing against it is that a torch, solder and several sleeves are needed. The writer suggests the following:

Use one piece of ½-in. round or hexagon cold-rolled steel that is ½ to 1 in. shorter than the drill to be used. Using a lathe, drill a hole clear through, using a slightly smaller drill first then going through the second time with the drill to be used, first honing down the sharp cutting points on the drill, so it will not cut itself too freely and use oil, as the drilling is done. Next, using a hack saw, cut a slot lengthwise through one side, except ½ in. on outer end, in order to not weaken the end. If the drill should fit loosely then close the sleeve together in a vise just enough to get a snug fit, so the drill will not drop out when the sleeve is not clamped in the drill chuck. The drill can then be set to suit and the drill chuck will clamp the sleeve enough to hold the drill. If the hole in the chuck is not deep enough to hold short drills a shorter sleeve will have to be made.

In drilling thin sheet iron that offers only a poor support back of the drill, I like to use a sharply tapered point. This shape, when the point goes through the sheet, gives the operator time to hold back his drill. This final cut is the hardest on the drill and most likely to break it.

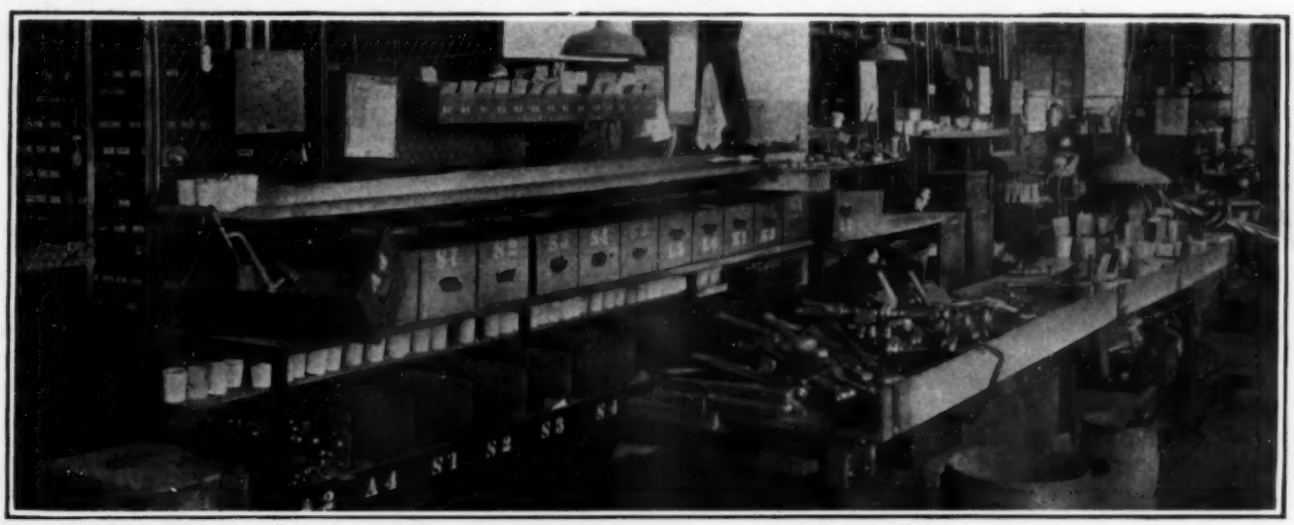


Fig. 21—The crib-supply tote-boxes and the sorting bench

Can Screw-Cutting Results Be Predetermined by a Shadow Inspection of the Chasers?

By Albert F. Breitenstein
Works Manager, Geometric Tool Co.

EVER-INCREASING demands for greater screw-cutting accuracy necessitate closer and more rigid inspection of the various screw thread elements. The introduction of shadow projection has done much to simplify inspection methods. However, the tendency is to use this method of inspection on the screw-cutting tools themselves as well as on the work produced by these tools.

Strange as it may seem, screw-cutting tools such as chasers of a self-opening diehead, due to the slight amount of freedom that is necessary for the chasers to function properly, often will cut a correct form of thread and lead, whereas the chasers may present a shadow that is slightly off in these two respects. This error is no fault of the shadow projector which, indeed, projects these elements exactly as they exist. There are some conditions to be considered in accurate screw cutting that cannot be determined by means of a shadow projection.

The lead, or helix angle of the threads on the chasers, has a marked influence on the results obtained. It is possible in the milled-thread type of chaser to vary the lead angle of the threads so that a plus-lead or a minus-lead screw can be cut as desired.

Support and Clearance

Threading chasers, to work properly, must have a certain amount of bearing or support while cutting. The support is dependent on the amount of circumferential and longitudinal clearance provided on the chasers. If the clearance is excessive, chattery threads will result and the lead of the screws will vary. If the clearance is insufficient, the chasers will rub too hard and rough threads will result. The chasers under such conditions will be short lived. The rubbing effect impairs the cutting action, creates a certain amount of resistance that will prevent the threading die from leading on readily, and tends to produce short leads.

The actual cutting of the die is done at the throat or chamfer. It is often possible to vary the lead of threads being cut with a certain set of chasers by merely varying the clearance angle of the chamfer. If the lead of the screw is short, increasing the clearance angle of the chamfer will make them freer cutting and this will decrease the resistance and permit the die to run ahead a little faster, thereby cutting a longer lead. If the lead of the screw is long, decreasing the clearance angle of the chamfer will increase the resistance and decrease the lead of the screw.

Lead variations may also be effected by grinding the cutting face at an angle. If the angle is such that the chaser is thicker at the front end than at the rear, the lead will be lengthened. If the angle is thinner at the front than at the rear, the lead will be shortened. Coarse threads offer greater resistance to cutting than fine-pitch threads. Multiple threads are even worse in this respect and the tendency is to cut a short lead. To overcome this condition it is often desirable to cut the threads on the chasers with a long-lead hob or tap. Lead-control chasers can often be used to advantage where close leads are required, but the most reliable method is to use a machine with a lead screw.

The machining properties of the material to be threaded also must be taken into consideration. Some materials offer greater resistance to threading than others. If chasers are properly ground for steel and then used on cast brass they will cut too freely and the result will be chattered threads and varied leads. It is frequently necessary after sharpening chasers for brass to dull them slightly by lapping to prevent them from cutting too freely.

Misalignment Means Trouble

The condition of the diehead and machine must not be overlooked. If the diehead is sprung or worn especially the parts that retain the chasers, there will be improper trackage and poor threading will result. If the machine is in an old and worn-out condition, it cannot be expected to produce accurate screw threads. Misalignment of the machine is always a source of trouble. Unsatisfactory screw threads are often caused by not using the proper type of diehead or machine. If a light diehead is used on a heavy machine, it should be provided with a floating shank in many cases. It is good practice to do light threading work on a light machine whenever possible.

The results obtained on hand screw-machines depend, to a large extent, on how the operator handles the machine. It is a well-known fact that long or short lead screws can be cut at will by simply forcing or holding back on the turret. Use of the proper cutting compound also is an important factor. If it is not properly suited for the particular material being threaded, results will not be satisfactory.

From the foregoing data it is obvious that the cutting accuracy of thread chasers can be best determined by inspecting the elements of the screws cut with the chasers.

Transmission of Knowledge

We hear a great many complaints regarding the inability to procure competent workmen these days, also their indifference to their various occupations. What are your superintendents and foremen doing to make your men better workmen and mechanics? Do they take the trouble to explain thoroughly to your men what it is you want them to do and the reason for doing it, or do they merely tell them to go and do the job, and when it is not completed to their satisfaction severely criticise them?

If the latter method is pursued, you lose time, and you also lose the co-operation of the men.

How often we hear complaints from superintendents and foremen that no job is done correctly, unless they are on the spot. This attitude acknowledges improper instructions to the men. Men are but human and if they all had the brains that the superintendent and foremen are supposed to have, they would not be workmen. If a little more time is taken in explaining thoroughly to your men what you want done, as well as the reason for it, you will find your departments running much more smoothly and there will be little trouble in getting co-operation from the men. In other words, reduce the friction loss on your personal transmission line, or knowledge, to its minimum.

A Policy That Catches Errors Before Production Begins

By B. J. Dowd
Factory Superintendent, Royal Typewriter Co., Inc.

Checking, re-checking and checking again as practiced in a typewriting plant has made tool and product losses occasioned by mistakes practically negligible

AS AN object lesson in how to avoid waste there is nothing more striking than a heap of scrapped parts or assemblies, discarded because of some mistake in the design or dimensions of part or tool that prevented their use in the finished product. Such an exhibit is unfailing proof that the human equation cannot be overlooked even in the mass-production plant of today. With responsibility divided to fall on many shoulders each individual must perform his allotted task with precision or the whole system slows down and stops.

A method of triple checks to make sure that no detail has been overlooked and that each man concerned has done his particular job has been successful at the Hartford plant of the Royal Typewriter Co., Inc., in preventing any appreciable loss because of an incorrect part or tool getting into production. Perhaps some of the refinements in the method would be hard to apply where a large product was involved, but with a comparatively small piece of apparatus, like a typewriter, they have served very well.

It is part of the company policy to require the factory executives and engineers to investigate every product suggestion or complaint that comes in, either from users or through the selling or service force. These are referred to the factory manager who generally passes them on to the factory superintendent. All complaints are first referred to the general foreman for check-up of manufacturing quality and if a change in product is required, are turned back to the factory superintendent for action.

The chief draftsman in consultation with the supervisor of design decides whether the change indicated affects tools or parts or requires the making of models. The word "model" in this connection refers to a hand-made sub-assembly of the typewriter mechanism.

If only a part is affected by the change the job is turned over to the product designer and the part drawings are changed accordingly. If the tools must be changed the job then goes to the assistant in charge of tool design. If a new model must be made it is referred to the assistant in charge of the model room. In any case a note is entered on duplicate work cards, Fig. 1, the original going with the job to the man assigned to handle it and the duplicate remaining in the chief draftsman's file.

Assuming that a particular complaint calls for a model change it will naturally follow that the model room will set to work and turn out hand-made models until one is made that is expected to overcome the difficulty complained of. The completed model is studied and criticised by the chief draftsman and factory superintendent and goes back to be improved. This cycle is continued until the model is approved by the factory superintendent.

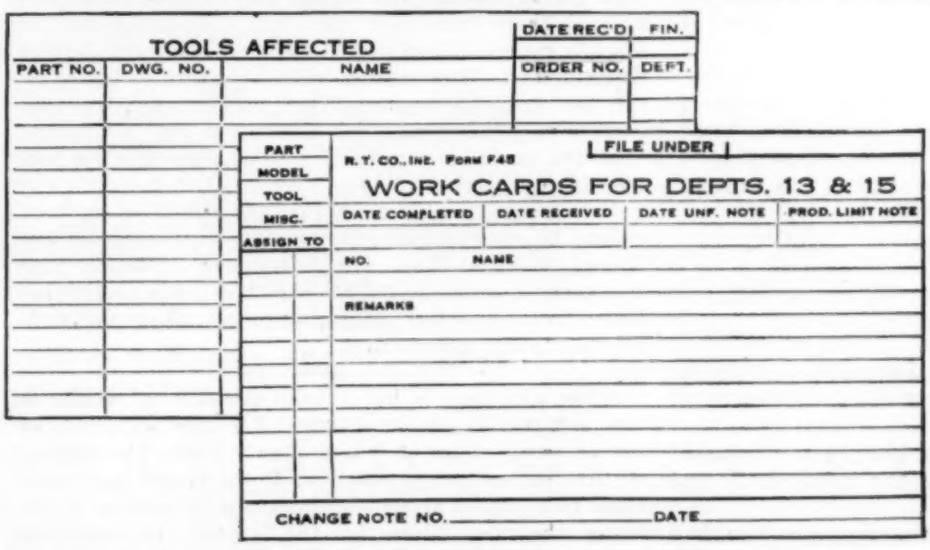


Fig. 1—Front and back of work card used by the chief draftsman to keep track of jobs in his department

The next step is to get the criticisms of the assembly department. In this department the model is scrutinized and tried on a stock machine to see how it fits and functions. Alterations to suit assembling department criticisms are frequently made.

The model is then shown to the factory manager who is in touch with the development through routine weekly reports. If it is considered to be ready for adoption, the manager submits it to headquarters in New York with definite recommendations. There the patent and experimental department, after exhaustive tests which include

actual tests by experienced stenographers, and further refinement if needed, send it up for final approval by the executives of the company. This approval is the end of the first check which is on the design.

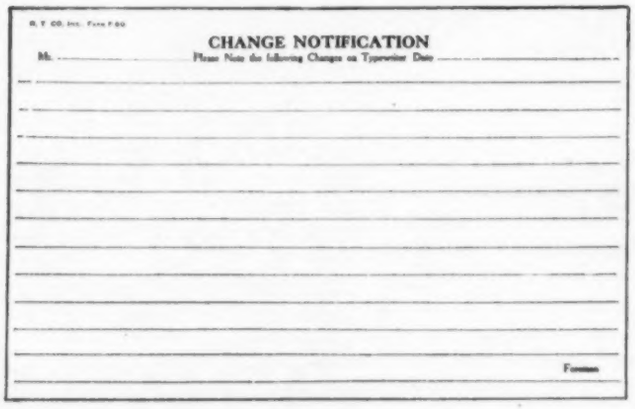
The model, having passed the first test successfully, is returned to the factory and goes to the drafting room so that new part drawings can be made. As he completes the changes the draftsman fills out change notification forms as illustrated in Fig. 2 and later one is sent to each department head concerned. The completed drawings must be approved by the chief draftsman, the supervisor of design and the factory superintendent.

The next step is for the model room to make up other models from the drawings, thus checking their accuracy. These models are thoroughly tested in the factory experimental department and assembly department. This constitutes the second check on accuracy of figures.

Then the necessary tool drawings are made and they in turn must pass muster before the supervisor of design and the superintendent. The work is now close enough to actual production for the master follow-up card, Fig. 3, to be made out. It goes to the follow-up man who is responsible to the supervisor of design, and takes its place in his file.

After the tools have been completed, models made from the tools by the tool or die makers, are submitted to the factory experimental department and the assembly department for test.

These models are treated in the same way as were the original hand-made models. With this final test out of


CHANGE NOTIFICATION

Mr. ..... Please Note the following Changes on Typewriter Date .....

Foreman

Fig. 2—Change notification form. This is filled out by the draftsman and sent to the department heads concerned

the way it is sure that all errors have been eliminated and production begins. This is the third check and insures accuracy of tools.

If only a part is concerned in the change rather than a complete sub-assembly that involves a new model, the work starts with the parts draftsman and follows the same routine as that described for the model, unless, of course, something develops that involves changes in other parts, tools or assemblies. The same thing applies to tool changes.

No matter which of the three classifications claims the job the follow-up man gets it after the tool and part

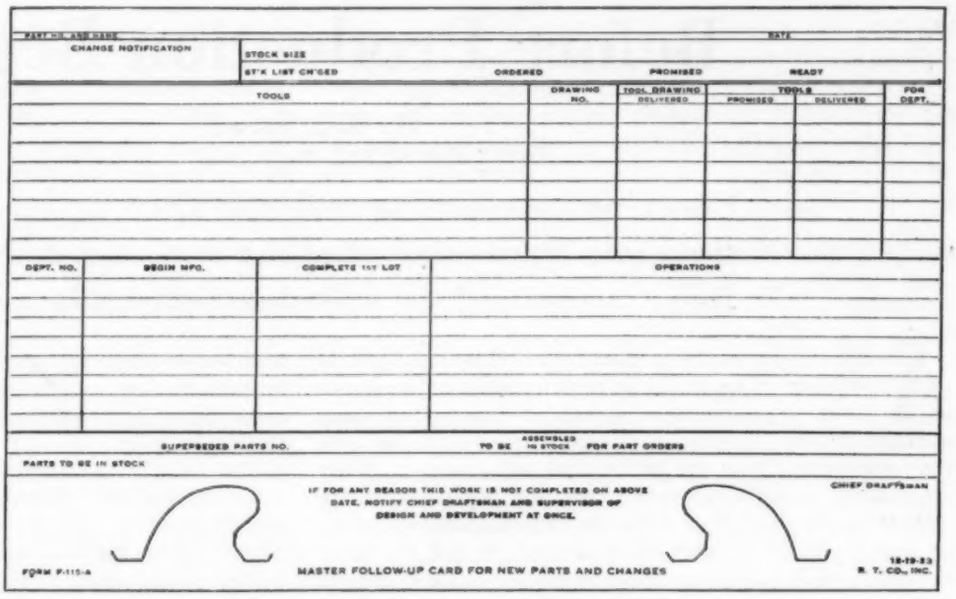


Fig. 3—Master follow-up card. Used by the follow-up men in getting a new part, tool or sub-assembly into production

drawings have been made. It is up to him to obtain parts inventories from which the supervisor determines the date on which the new device must be ready for assembly on the finished typewriter. This follow-up system also takes care of the planning on the first lot so far as tools, and so forth, are concerned. After the first lot has gone through, the part is assumed to be in regular production and the follow-up system is finished with it.

Changes in product that involve new additions to the typewriter as opposed to refinements designed to take care of suggestions or complaints from the field, usually originate in the patent and experimental department in New York. Models embodying the new ideas are developed there and must then pass inspection by the officials connected with the inventive, sales and service departments. They then go to Hartford to be tested by the factory departments. They are also tried out by factory stenographers.

If the model is approved for use, the routine previously described is followed.

It is a rigid requirement that the full checking procedure be carried out no matter how unimportant the change involved may seem. In some instances this insistence is probably unnecessary but it has meant that losses from imperfect design, inaccurate figures or tools are practically non-existent.

After all, there is but a fixed quantity of wealth in this country at any fixed time. The only way that we can all secure more of it is to create more. The element of time enters into production. If the people have sufficient moderation and contentment to be willing to improve their condition by the process of enlarging production, eliminating waste, and distributing equitably, a prosperity almost without limit lies before us.—*The President's message.*

The Weighing Scale —An Instrument of Precision

Peculiar graduations of scale beams — The "range" of a beam—Standard weights calibrated by Bureau of Standards

By Ellsworth Sheldon
New England Editor, *American Machinist*

THOUGH there are many beams used in the construction of a weighing scale there is but one member that the scale maker recognizes by that designation, and that is the "weigh-beam," or graduated bar along which the movable poise slides or from which the standard "weights" are suspended.

There are, however, many forms in which the beam may appear, and almost as many different graduations as there are countries in which the scale is used. All of us know what a pound is and many of us know the kilogramme, but outside of a scale shop such terms as "catty," "oka," "arratel," "rotolo," "viss," and many other designations would appear to most of us but jargon; yet scale makers know that these terms denote standards of weight in the respective countries to which they belong.

TABLE OF FOREIGN STANDARDS

Pound	English	7000.00 grains
Kilogramme	French (Metric)	15432.35 grains
Libra	Spanish	7112.67 grains
Funt	Russian	6319.86 grains
Pound	Old French	7555.10 grains
Catty	Chinese	9333.33 grains
Katte	Javanese	9531.018 grains
Pfund	Prussian	7716.174 grains
Pund	Danish	7716.174 grains
Oka	Turkish	19798.92 grains
Pound	Amsterdam	7625.00 grains
Pound	Dutch	7625.00 grains

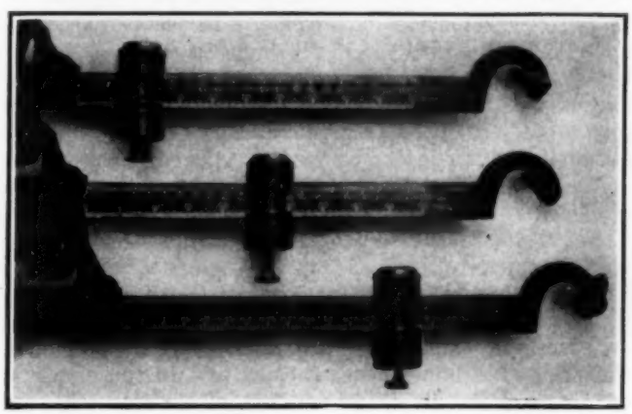


Fig. 1—Scale beams with double marking

Skalpund	Swedish	6560.98 grains
Arratel	Portuguese	7083.00 grains
Seer	East Indian	14400.00 grains
Rotl	Moorish	8330.00 grains
Rotolo	Maltese	12250.00 grains
Viss	Burmese	25550.00 grains
*Libra	Mexican	7102.62 grains
Pound	Austrian	8642.20 grains
Cate	Philippines	9779.92 grains
Catty	Siamese	9333.33 grains
Momme	Japanese	57.8713 grains

* Mexico has now adopted the metric system.

Photographs and data by courtesy of the Howe Scale Co., Rutland, Vt.

In Fig. 1 are shown three beams for the ordinary platform scale, each with a double marking. The upper one will probably go to Spain or to some agency dealing with Spain, and it is therefore marked with the standard "libra" of that country and with the more

Fig. 2—Locating the center of gravity

universal kilogramme. The middle one goes to South America where both the pound and the kilo are well known, but about the only country that could find use for the lower one is China, for the markings (the Chinese catty) would be unintelligible to anyone but a Chinaman—and a maker of scales.

In order to make a practical scale beam it must be suspended from a point somewhat above the center of gravity, so that it becomes in effect a pendulum. The weight of the beam, including all weights attached to or suspended from it, must be so distributed that the actual center of gravity is directly below the point of suspension when the beam is horizontal; tending to hold it at rest only in this position.

This is the "range" of the scale. In very sensitive instruments it approaches, but never quite reaches, zero. The beams of such scales will vibrate for a comparatively long time before coming to rest. In commercial scales where extreme accuracy and sensitiveness is not quite so essential the range is greater and the period of vibration much shorter.

The manner of locating the range point in a scale beam is very simple; whether the beam is a single bar or consists of three or four bars, as many of them do. The device shown in Fig. 2 is an even balance scale

constructed within a framework, the actual scale-beam being double and located near the top of the frame. Suspended from the double beam is a flat plate supported at the four corners so that as the beam vibrates up and down within the limits of its yoke the plate moves with and is always parallel to it.

Scribed across the plate at right angles to its length are a number of evenly spaced and numbered lines, the zero line being at the center and coincident to the point of suspension of the scale beam. In other words a weight of uniform section placed exactly across the center line would not disturb the balance.

To find the center of gravity of a new beam the latter is first equipped with all of its parts—poise, balance weight, etc., that are to remain a component of the completed beam—and is laid upon the plate as shown in the illustration with its graduated edges parallel to the cross marks. It does not matter which mark is chosen, as the latter are not measurements; they are put there so that the beam, when finally mounted in its scale, will hang horizontally.

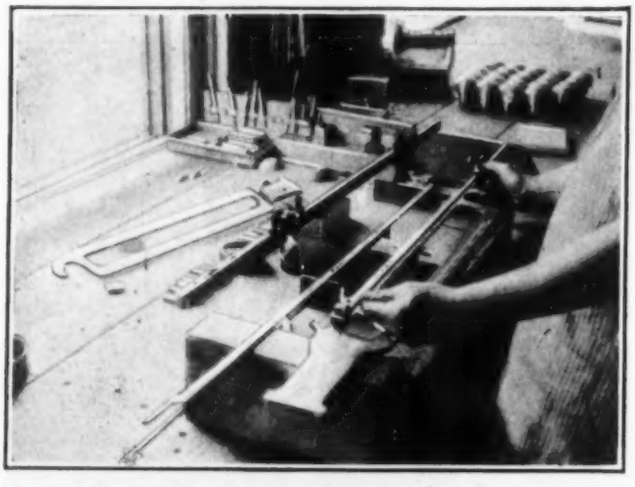


Fig. 3—Laying off intersections for pivots

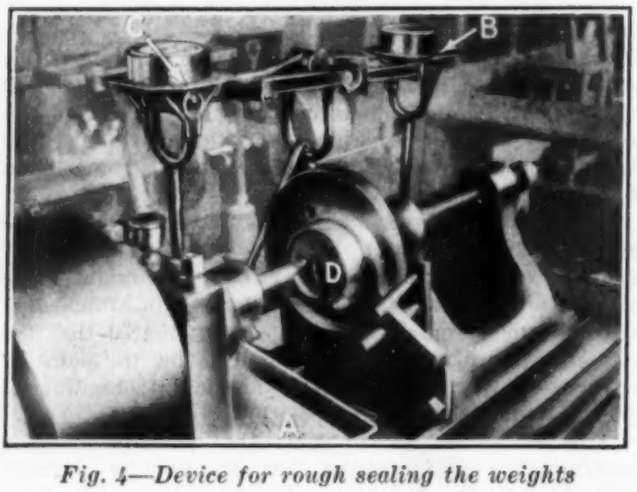


Fig. 4—Device for rough sealing the weights

The workman then moves the beam sidewise, one way or another, always keeping it parallel to the scribed lines, until the scale is in balance. A line is then laid along the new beam with a straightedge and scriber that is coincident to the zero line on the plate; this line representing the center of gravity widthwise of the beam. From it the range will be determined by measurement.

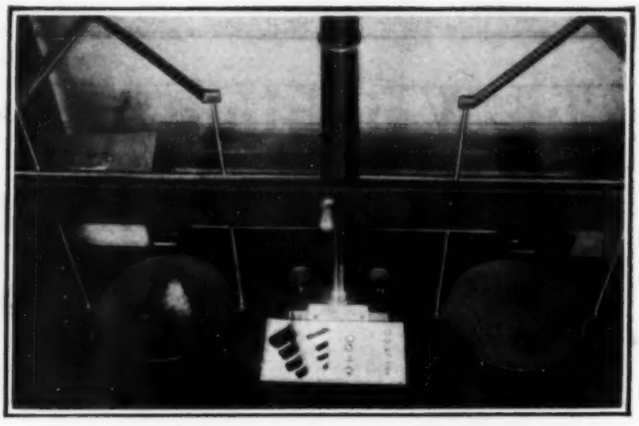


Fig. 5—Balance upon which the smaller standards are sealed

The location of the pivots with respect to each other lengthwise of the beam is of equal importance, but this is a matter of mathematical calculation and measurement rather than of balance. The middle point is first located with respect to the graduations already on the bar, and the end pivots are then laid off from the middle one by means of a special trammel having a vernier at its movable point.

It is, of course, necessary that the middle point should be at the center of gravity lengthwise of the beam, but as the actual center of gravity in this direction can be shifted endwise an inch or more by the simple expedient of turning the balance weight on its threaded screw, the point is determined rather by the designer than by the layer-out.

The workman in Fig. 3 is engaged in laying off the intersections for the pivots by means of the trammel. After the lines are scribed, holes are drilled at the intersections and these holes are broached out to the peculiar shape of the pivots.

The pivots are cut from bars that have been rolled at the steel mills to the special section desired, which may best be described as triangular with one side of the triangle rounded. It is called in the shop "chestnut-bar"; being in fact much the same in shape as a section of that once familiar nut. It requires no machining except to grind the edges sharp and to temper the pivots before they are set into the beam. So carefully is the preliminary work carried out that any adjustment of the pivots when the scale is sealed may be done with a hone.

Not the least interesting device around a scale shop is that shown in Fig. 4 for "rough-sealing" the standard weights, which scale makers are called upon to furnish in great quantity, in various sizes and to the many standards in existence. The device is mounted upon the back of a hand lathe and the tool in the chuck is an ordinary flat drill. It consists of an even-balanced scale beam with a two-way graduated bar; that is, the poise may be moved either way from the center, or neutral, point. At each end of the beam is a small platform for standard weights, and suspended from the end nearest the drill is a frame that carries a sheet metal pan *A* that projects over but does not touch the lathe bed. With nothing on either platform, nothing in the pan and the poise at zero on the beam, the scale is in balance.

The operator has a stack of, let us say, 1-lb. weights to be sealed. He selects from his cupboard a 1-lb.

bronze standard and a 1-lb. cast-iron weight that is slightly "heavy." He puts the bronze standard on platform *B*, where it remains during the entire operation, lays the iron weight aside for the moment, and places one of the weights to be sealed on platform *C*; which immediately falls because the new weight is heavier than the standard. He then restores the balance of the beam by sliding the poise toward the bronze weight.

He now drops the casting (the one he has just balanced on the scale) into the holder of the tail spindle as shown at *D* in the illustration and puts the "heavy" iron weight in its place on the platform; the bronze standard remaining down because it, in conjunction with the displaced poise, is considerably heavier than the iron weight. The operator now proceeds to drill into the casting in the holder until the weight of chips accumulating in the pan has restored the scale to balance; when he knows that the casting he is drilling is exactly equal in weight to the "heavy" iron weight on the platform. The reason why the iron weight is heavier than standard is so that the driller in his zeal to make time will not overshoot the mark, for it is a great deal easier to reduce the weight of a casting than to increase it. The final sealing is a much more delicate operation.

That a balance capable of responding to a "load" equal to the one-hundred-thousandth part of an ounce should play any part in the building of scales to withstand and register a weight of 100 or more tons seems inconceivable; yet the little balance, shown in Fig. 5 with its minute weights ranging from $\frac{1}{100}$ to $\frac{1}{100,000}$ ounce, is the mentor that establishes a check upon the accuracy of all scales built in the shop.

In Fig. 6 the master-sealer, whose word is the final authority around the shop in any matter pertaining to weights, is shown at the balance. The case at his right

Fig. 6—"Sealing" the standards

hand contains standard weights of bronze ranging from 1 to 50 lb., all but one of which are silver plated. The exception is the 1-lb. weight in the lower left hand corner of the case, and this one is heavily plated with gold.

The weights are always handled with chamois gloves or with tissue paper; never with the bare hands. They are ordinarily taken out of the vault but once each year, at which time they are sent to the Bureau of Standards in Washington for verification, and used during the few days following their return to check the various bronze weights that are the working standards of the shop.

For six weeks each year the master sealer is shut up in his little room in the Engineering building, much of the time alone, and during that time every standard weight in the shop that is used for checking other weights is "sealed." The work is done in the winter because at that season the temperature of the room is more easily controlled. Doors and windows are tightly closed, automatic temperature regulating devices, supplemented by indicating and recording thermometers are put into action, and anybody that wants to talk to the master sealer can do so—by telephone, if his business is of sufficient importance to warrant.

Though little variation in weight of the standards is found from year to year, a peculiar fact is that when a variation is found it is almost invariably in the direction of excess weight. Despite the constant handling to which the shop standards are subjected, this excess may sometimes amount to as much as a BB shot in a 500-lb. weight.

Every standard has a small hole drilled in the bottom, and this hole is plugged with lead. Correcting the standard is done by scraping out a small portion of the lead, or by introducing more if by any chance the variation is in the other direction.

The Center Punch

By Charles Homewood

Since the accuracy of a good many jobs depends entirely upon the layout, I wish to call attention to the importance of our old friend, the center punch. Of all the tools used by the general mechanic, it seems that the center punch gets more knocks and receives the least attention of them all. Yet if this little tool is given the proper consideration, it will be found that a good many inaccurate jobs are the direct result of using a type that was not properly adapted to the work.

From the big, heavy, mogul center punch of the general machinist down to the fine automatic of the tool and diemaker, the angle to which the point is ground must be in accordance with the class of work at hand, and we should always bear in mind that it is the extreme point of the punch from which we should work. Some jobs are not accurately done because the punch marks are made too deep, especially when using the dividers to scribe a circle or radius. It is very evident that the deeper the punch mark, the more the extreme point is liable to depart from the original layout line, because the punch is seldom held at a right angle with the job. Except for use on very rough work, it is advisable to have all center punches ground by machine, in order to insure a true, round point.

Where small holes are to be drilled in accurate locations, such as in die work, it is very important that the center-punch marks be true in shape so that the drill will be properly centered. If the punch marks are oval or angular, the drill will be apt to run and the resulting holes will not be in their intended location.

A center punch having the point ground to an included angle of 60 deg. is most satisfactory for use in connection with the dividers, where circles are to be scribed. The mark from a punch so ground will leave room enough for the inclination of the stationary leg, and at the same time provide a satisfactory resting place for the point.

Book Reviews

The Tragedy of Waste. By Stuart Chase. Two hundred ninety-six pages, 5x7 in. Published by The Macmillan Co., New York, N. Y. Price $2.50.

Few of us agree with John Stuart Mill who once said that it was doubtful if all the labor-saving devices invented had lightened the load of a single human being, yet Mr. Chase shows us how a large part of the good that might flow to mankind from applied science, is diverted or dissipated by various forms of waste. Mr. Chase makes us realize what he considers waste by using the word "illth" to designate wastes in consumption, as distinguished from real wealth, which seems to fit the case very aptly as we become accustomed to it.

It is impossible to go into the details of his presentation of the case further than to say that he points out the main channels of waste, such as the wastes of production; of distribution, which includes transportation with its miles of cross- and back-hauling, unnecessary sales costs and other factors; wastes through lack of co-ordination; idle man-power and the wastes of consumption. Mr. Chase has evidently made a very careful study of the subject from many angles and quotes such authorities as Secretary Hoover, Edward Filene, Dr. Harvey Wiley, Col. L. P. Ayers and others.

Excess plant capacity, which is usually built when labor is in demand for useful product, and industrial decentralization are also considered, the latter on the authority of no less a manufacturer than Henry Ford, who says "that highly standardized, commercial industry need no longer become concentrated in large plants with all the inconveniences of transportation and housing that hamper large plants. A thousand or five hundred men ought to be enough in a single factory."

While there is much in this volume with which the average business man may not agree, it will afford him much food for thought and should suggest ways in which he may eliminate some wastes in his own business.

Physical Metallography. By Marcus A. Grossman. Four hundred and forty 6¼x9¼-in. pages, cloth bound. Illustrated. Published by John Wiley & Sons, Inc., New York, N. Y. Price $6.

In this book the author gives a "somewhat augmented" translation of an excellent treatise by the late Professor E. Heyn of Germany. Those familiar with the writings of this eminent metallographist will appreciate the author's translation of such a well arranged book of clearly defined metallographic principles. Professor Heyn had the exceptional ability of injecting into the study of modern metallography a simplicity not lacking in completeness. He frankly states, however, that a study of this kind is necessarily very comprehensive and leads one into a "multiplicity of sciences."

The brief general survey of metals and alloys, given in Chapter I, serves the useful purpose of preparing the reader's mind for the chapters to follow. Thus, Chapter II treats of the theory of equilibrium in alloys and makes use of Gibb's phase rule to a greater advantage than has been the case heretofore. He states that this rule "is a valuable guide through the manifold phenomena to be observed in the different alloys" and that "the disclosures of the phase rule must be supplemented by the results of the theory of structure." Two chapters are devoted to the description and preparation of binary and ternary diagrams for different conditions of miscibility, chemical combinations, transformations or developments during heating or cooling both before and after solidification. A brief but very important chapter on the use of the X-Ray for determining the atomic structure of metals adds to the progressive character of Heyn's work. He states that "this method has opened a very fertile field of research in the structure of crystals" and that "the X-Ray will rapidly come to the fore as an instrument of use to the metallurgist."

Of interest to the practical designer of machine parts is the chapter on the properties of strength and hardness, which gives certain points of view in the selection of materials. In this connection, however, qualification should be made to the effect that the yield point is not always a close approximation of the elastic limit at elevated temperatures. The part covering the change of physical properties by either cold or hot working is likewise of practical value. Tests for determining notched impact and ball hardness numbers as well as magnetic properties are discussed at considerable length. Interesting chapters are devoted to the subject of gases in metals and the formation of shrinkage cavities or "pipes." A biographical index placed in the fore part of the book should prove to be useful, although it is by no means comprehensive.

A.S.T.M. Tentative Standards 1925. American Society for Testing Materials. Eight hundred seventy-six, 6x9-in. pages. Illustrated. Published by the society at 1315 Spruce St., Philadelphia, Pa. Price, paper bound $7, cloth bound $8.

The 1925 edition of tentative standards is an imposing testimonial to the activities of the standards committees of the American Society for Testing Materials. The volume contains 194 tentative standards relating to steel, ferro-alloys and wrought iron, non-ferrous metals, cement, lime coatings, petroleum products, road materials and many others.

The tentative standards proposed and contained in this book are published for trial and are subject to the criticism of those who use them before final adoption as standards. Photographs and diagrams are used in a large number of cases to simplify the explanation of the standards for which materials covered, processes, analysis and inspection are typical paragraph heads.

Origin of Quenching Cracks. By Howard Scott. Published by the Bureau of Standards. Scientific paper No. 513. Pages 399 to 444 inclusive, of Vol. 20. Price 20c. The author reports the conclusions of experiments on oil-quenching and water-quenching of steel. A study was made of the conditions producing cracks during quenching and of the control of quenching cracks.

Illustrations, diagrams and tables relative to the subject are included in the paper.

Flow in a Low-Carbon Steel at Various Temperatures. By H. J. French and W. A. Tucker. Technologic Papers of the Bureau of Standards, No. 296. Pages 619 to 640 of Vol. 19. Published by the Bureau of Standards. The authors record the results of experiments on elongation in 0.25 per cent carbon steel subjected to a fixed total load in tension at approximately constant temperatures. The experimental results are summarized by means of graphs and in tables, and the conclusions are given.

Recent Progress in Coating Steel Springs to Resist Corrosion

By Joseph Kaye Wood
Consulting Engineer, New York City

The application of non-corrosive metallic coatings to steel spring surfaces—The effect of the processes on the spring characteristics—The Madsen process and its promise for a successful solution of the problem

WHEN steel is considered from the standpoint of spring characteristics only, it is unquestionably the best material known to the metal-spring art. If, on the other hand, spring steel is considered from the broader viewpoint of meeting requirements of mechanical design in general, it is often condemned as a very unsatisfactory material.

Among these various requirements, that of resistance to corrosion is probably the most important, since the self-accelerating process of rusting is serious. If this defect could be eliminated, the value of steel springs to the various mechanical trades would be greatly enhanced.

CORROSION is an ever present enemy to the successful operation of machinery and mechanical devices of all description, an enemy for which we have yet to discover a dependable opponent. For such parts as springs and particularly those used in delicate apparatus the problem is a serious one and warrants more thought than it has received commercially to the present time. This article is aimed to stimulate the necessary interest.

The seriousness of corrosion depends largely upon the relative minimum thickness of the spring. For a given depth of the corroded section, whether it be just a pit or a widespread area, the thinner spring is affected mechanically to a larger extent. The reason that this variation is magnified for a small difference in thickness is to be found in the fact that the usual spring formulas, for load-deflection rate, maximum safe load and maximum safe deflection, require the thickness term to be raised to powers ranging from unity to as high as 4.

Thus small springs ranging in thickness or diameter from about 0.010 in. to about 0.062 in. require specially good protection from corrosive influences, particularly when high humidity and corrosive gas are to be encountered. Springs of this size, both flat and coiled, are used in great quantities in typewriters, adding machines, pump diaphragms, automatic telephone equipment and control apparatus in general.

Attempts have been and are being made to use steel for this above class of springs, protecting the steel with metallic platings such as tin, copper, nickel and combinations of these metals. So far, satisfactory results on a commercial basis have not been obtained. Hence, where possible from the purely elastic standpoint, nickel, silver, phosphor bronze, monel metal and brass have been substituted for steel.

From this statement it should not be implied that these materials are entirely free from deterioration, for example, season cracking in brass, although this is a somewhat less serious question than the self-accelerating corrosion of steel.

In the case of springs of greater thickness, where the effect of corrosion is less serious from a mechanical standpoint, the matter of protection is a much simpler problem. Large springs may be given an oil finish or no finish at all while medium-size springs are usually black japanned or just simply painted. Frequent oiling or greasing of unfinished springs while in service protects them against severe corrosion.

Small springs are, therefore, most worthy of attention where protection platings or finishes are concerned. In those cases where non-ferrous metal springs cannot be used, due to lack of strength within the proportional limit, and such cases occur frequently on account of space limitations, steel, adequately protected against corrosion, must be used.

The question might be asked as to why stainless steel cannot be used and thus eliminate the necessity of a plating or finish. The answer is that, with the ordinary chromium type of stainless steel, polishing is required to obtain the best resistance to corrosion.

The resistance to corrosion and the spring characteristics of such a steel are dependent upon the degree of hardness, although both are not a maximum at the same point. In the anstenitic or high-chromium, high-nickel type of stainless steel the spring characteristics are somewhat inferior and the toughness is objectionable from the standpoint of machinability.

It is obvious, therefore, that plating or finishing of the regular type of steel is necessary. Metallic platings are preferable to any type of finish such as japanning, painting or oiling. Bower-Barffing or Parkerising which make excellent although not perfect finishes on rigid pieces of steel, are not so satisfactory for springs.

Two general methods are used in coating steel springs

with metallic plating, namely, the "molten bath" and the "electro-plating" methods. In either method the surface of the steel to be plated has to be properly prepared.

For plating with tin, the molten-bath method is used in which the steel spring is first sand blasted and then dipped in rosin before placing in the molten bath of tin the temperature of which is held at about 280 deg. F. The heat affects the elastic properties of the spring to a slight extent, but not enough to be objectionable. On the other hand, when this method is made continuous for rapid production of large quantities of small springs, unwarranted fluctuations of the bath temperature may cause a serious change in the elastic properties of some or all of the springs. Sand blasting, when properly done, is quite costly and is likely to prove detrimental to springs of thin section.

Tin plating, however, when properly performed, gives a good coating for springs, since it is quite ductile and fairly free from porosity. Steel springs after tin plating cannot be heat-treated or used at greatly elevated temperatures.

Electro-plating of steel springs with copper is accomplished by suspending them at the cathode in a tank containing a solution of copper cyanide. The current density and voltage employed depend upon conditions such as temperature, inner-electrode distance and strength of solution. In a moving cathode tank and at a temperature of about 150 deg. F. the current-density rate might be about 500 amp. per sq.ft. per minute.

Previous to copper plating, the springs must be thoroughly cleaned, not as understood in the ordinary sense, but from a chemical standpoint. Besides removing all visible grease, dirt and rust, the cleaning must remove tarnish or other microscopic films which might interfere with proper adhesion of the metallic coating to the spring.

Before plating, therefore, the springs are placed in a tank containing a cleaning solution at a temperature of about 180 deg. F. Very good and quick results can be obtained with this solution when used electrolytically. In this manner the work which is made the cathode, is thoroughly cleansed in a few minutes, providing that a current density of at least 10 amp. per sq.ft. is maintained.

The cleaning does not complete the preparation of the surface for electro-plating however. It must be microscopically roughened in very much the same manner as is done on a larger scale in the building trades when they apply cement or other type of plaster to a vertical wall. The springs must be pickled, as the next operation, which consists in placing them in a weak solution of muriatic or hydrochloric acid. This is followed by dipping them in a solution of sodium cyanide or some such other solution that will neutralize the pickling acid and thus check the "roughening" action. A final rinsing in cold water completes preparation for the plating operation.

THE AUTHOR'S discussion of the subject brings out a number of points that are not generally understood outside of the laboratory, among them the effect of hydrogen liberated in the plating process. The article in general serves to point out that there is a great deal more to the process of covering steel with the various metallic coatings than by simply dipping them in this or that solution and many service requirements that are limited by the known processes.

Copper plating steel springs is unsatisfactory in many ways. In the first place the springs are made quite brittle, the extent of which depends upon the variation of certain factors involved in the plating process. The embrittlement is due in most part to the occlusion of atomic hydrogen by the steel spring. Hydrogen in this free state is liberated at the cathode.

Molecular or ordinary hydrogen gas is not absorbed by steel and for this reason it is felt by the writer that the embrittling effect is due to the diffusion of hydrogen atoms into the space lattice of the steel. For instance, it has been found that the osmostic pressure in the affected area may reach as high as 14 atmospheres. Increasing the internal pressure has the equivalent effect of placing the steel in an external medium which exerts a hydrostatic tension on it. According to A. A. Griffith,[1] a ductile metal would be made brittle if it could be subjected to a hydrostatic tension.

In any case the embrittling effect of atomic hydrogen liberated in a copper electro-plating bath is highly objectionable. It is particularly objectionable in the case of small springs for the same reason that corrosion is objectionable, namely, the effect on the mechanical strength of the spring increases as the ratio of depth of hydrogen penetration to spring thickness is increased. Although the hydrogen can be driven out by heating the spring to about 500 deg. C. this is not a remedy because the springs would thereby lose their elastic qualities.

Other defects, often found in copper-plated steel springs, are peeling, porosity and wear. The latter defect is not due so much to the poor wearing quality of the copper plating, but to the fact that, of necessity, the plating cannot be very heavy and is therefore quickly rubbed through to the steel surface. The lack of adhesion is due in part to commercial variation and in part to the lack of an improved method in the preparation of the steel surface previous to plating.

Due to the embrittlement of steel springs by atomic hydrogen in copper plating, a combined method of plating has been developed, wherein some metal other than copper which would not give rise to occluded hydrogen or would greatly reduce it, is first plated on the spring. Thus springs have first been coated with tin by the "molten bath" method and then electroplated with copper. The tin plating, when properly applied, is impermeable to atomic hydrogen, which permits copper plating to follow without fear of embrittlement.

T. S. Fuller, metallurgist with the General Electric Co., gives some very interesting results in his paper, "The Prevention of Brittleness in Electro-Plated Steel Springs."

Test springs of the helical form were made from 0.120-in. black wire and as nearly alike as possible to eliminate or make unappreciable the effect of dimensional variation on the breaking strength. The results

[1]The Phenomena of Rupture and Flow in Solids. *Transactions*, Royal Philosophical Society of London, 221, 187.

were determined by means of an Olsen tensile testing machine. The tests and their results were as follows:

Of the seven unplated springs that were tested, five broke above 400 lb. and all broke at loads between 310 and 439 lb. The permanent stretch was two or three times the original length of the springs. Two springs, copper plated after the cleaning, broke at 69 and 147 lb. and stretched very little. These springs were in the copper-cyanide solution for about ½ hour.

The figures thus quoted show a very considerable reduction in the strength of the springs due to copper plating. That this decrease in strength was due to brittleness is shown by the large reduction or practical elimination of the permanent stretch.

Two springs were dipped directly into rosin and then into molten tin at a temperature between 260 deg. and 300 deg. C. These springs, when tested, broke at 300 and 352 lb. showing only a slight decrease in strength as compared with unplated springs. Six specimens were then sand-blasted, dipped in rosin and tin and finally copper plated in the copper-cyanide solution. Upon testing these springs in the Olsen machine, breaking loads of 318 to 417 lb. were obtained. These tests showed that the coating of tin was sufficient protection against occlusion of atomic hydrogen by the steel springs.

The Effect of Long Periods of Pickling

Another point brought out in Fuller's paper was the effect which long-time pickling has on the mechanical strength of the springs. A spring pickled for 3 minutes, and one for an hour in a 20 per cent sulphuric acid solution, resulted in a breaking strength of 198 lb. for the former and 29 lb. for the latter. The diameter of the wire in the spring pickled for one hour was reduced by 0.001 inch.

This test would indicate that all loss of strength cannot be due to embrittlement by the atomic hydrogen of the plating bath, but depends, as pointed out previously, on factors involved in the preparation of the steel surface.

The writer has found, in his own experience, that if coils of steel intended for spring production are not properly guarded against corrosion, the time required for pickling or cleaning will be greatly enough increased to cause a decrease in mechanical strength.

In the case of the combined tin-copper plating, described previously, no pickling is necessary and consequently this method is free from the defects just mentioned besides being free from the embrittling effect due to occluded hydrogen.

A large number of springs are being plated now with nickel by the electrolytic method. Hydrogen is also occluded in this case, but not to such a great extent as in the copper-plating process. In fact, G. B. Hogabloom of the Bureau of Standards has stated that if, in nickel plating, hydrogen is deposited primarily steel springs will become brittle. By correcting the solution so that hydrogen would not be deposited primarily the brittleness of the spring would not occur. By correcting the solution is probably meant regulating the amount of H-ion concentration.

A typical nickel-plating solution is as follows:

Double-nickel salts—6 oz.
Single-nickel salts—7 oz.
Ammonium chloride—3 oz.
Boric acid—1½ oz.
Water—1 gal.

The purpose of ammonium chloride is to lend conductivity to the solution while the boric acid prevents the formation of basic salts at the cathode where the springs are suspended. As in the case of copper plating, the springs must be chemically cleaned and pickled before plating with nickel.

The process described for copper plating may likewise be used for nickel plating or the springs can be pickled in potassium-cyanide solution. In this plating operation a high current density, about 15 to 20 amp. per sq.ft. is used to start with and, toward the end, a current density of 5 to 19 amp. per sq.ft. is used.

Steel springs are affected much less in nickel plating than in copper plating. By proper control, nickel plated springs can be produced that are quite free from brittleness due to occluded hydrogen. They are still unsatisfactory in other respects, such as porosity of plating and lack of adherence. Nickel, however, has been used as a preliminary coating to copper, and for certain uses small springs are being coated with a combined plating of nickel-copper-nickel.

The Madsen Process of Nickel Plating

Nickel platings have, on the other hand, proved to be quite finicky in commercial practice. Several investigators, notably C. P. Madsen, have been engaged during the past few years in determining ways and means of improving the process of nickel plating. Madsen has developed a remarkable process for this purpose which is particularly serviceable for small springs, because the cleaning operation removes little or no iron from the steel surface and embrittlement and other defects of ordinary nickel plating processes are eliminated.

In the Madsen process the aim is to produce a nonporous, homogeneous, adhering and more ductile nickel plating without affecting the physical properties of the steel. First the springs are cleaned or pickled as described previously, notwithstanding that Fuller's results showed them to be greatly weakened by this operation. The next operation consists of a special treatment, the purpose of which is to assure perfect adhesion of the nickel to the surface of the spring and to remove any hydrogen absorbed by the spring during the cleaning or pickling process.

For this purpose the springs are placed as the anode in an electrolytic bath consisting of a concentrated solution of sulphuric acid. The per cent of concentration is never allowed to be less than 85 while it is usually kept higher to make allowances for absorption of moisture from the air.

The current density at the beginning of the operation is about 30 amp. per sq.ft. but drops off to zero after a few minutes. According to Madsen, this operation decarburizes the steel to a very slight depth, thus giving an ideal "keying" type of surface for the adhesion of the nickel. Madsen has informed the writer that carbon monoxide is liberated at the anode and that the rate at which the current drops depends upon the amount of carbon in the steel. As the carbon in spring steel is usually high, the rate of current decrease is relatively low.

No better type of "keying" surface can be produced than by the foregoing method.

In the plating operation Madsen aims to eliminate four of the common defects found in ordinary electrolytic nickel. These are, lack of ductility, presence of "carbuncles," failure after annealing or "cold short," and the presence of "pits."

Lack of ductility is not caused entirely by the occlusion of atomic hydrogen, but is due principally to soluble organic compounds in the nickel plating bath and to iron.

According to Madsen, "Practically all of the organic matter can be completely removed or destroyed by chlorination; the effect of small amounts being inhibited by hydrogen peroxide."

Carbuncles are caused by floating or suspended insoluble particles somewhat above colloidal size, and their formation is aggravated by too high a current density. The practical remedies are to use pure nickel anodes and to keep the bath free from foreign matter such as dust.

Cold-short in the deposited nickel is due, according to Madsen, to true colloids on intercrystal facings, which probably enlarge upon heating, thereby rupturing the crystal bondage. These colloids are removed by ordinary filtration.

Pitting is caused by fine particles of living organisms and ferric compounds, which act as catalysts and cause the formation and discharge of atomic hydrogen at the cathode. The remedy for this defect and most other ills of electrolytic nickel were found in the introduction of small amounts of hydrogen peroxide in the bath which in effect allowed the hydrogen content to vary over wider limits without deleterous effects.

A bath first developed by Dr. O. P. Watts but modified in accordance with the remedies found by Madsen, as outlined above, is used in the Madsen plating process. Watt's bath consists of 240 gm. of $NiSO_4 7H_2O$, 20 gm. of $NiCl_2 6H_2O$ and 20 gm. of H_3BO_3 all desolved in a liter of water. This bath is kept at 130 deg. F. and the current density employed is 36 amp. per sq.ft.

"With the use of commercially-pure nickel anodes, which contain no oxygen or injurious metallic elements except a small per cent of iron, the addition of 1 to 4 c.c. of a 3 per cent hydrogen-peroxide solution per liter of bath initially and then 4 c.c. every 24 hr. of operation, ensures absolute freedom from pits. The pure nickel anodes consist of a eutectic of tin-nickel carbide and pure nickel, and as stated, it is absolutely free from metallic impurities except for a mere trace of iron. The total absence of oxygen is assured by the high-carbon content."

The Madsen process thus briefly outlined appears to offer the most promising method for coating small steel springs with a plating that will adequately protect the springs against corrosion. The nickel plating thus provided is ductile, homogeneous and free from porosity. The physical properties of the spring itself are not affected by either the surface "keying" treatment or by the depositing of nickel.

It is too soon to determine the commercial aspects of the process, although like in the case of all meritorious technical developments it is hoped that it will pass this stage successfully.

The entire subject can be summed up in the comparatively few words that relatively little has been actually accomplished in the total elimination of rust or in proofing various materials against its inroads so its menace can be neglected.

There has, on the other hand, been a great deal of work put in by experimenters and by practical application in the right direction. There is sufficient encouragement by way of results to warrant the hope that the problem may finally be solved.

Seen and Heard

By John R. Godfrey

Inspection—foolish and otherwise

IT HAS been cynically remarked that inspection has deprived users of as much good material that was badly needed, as it has saved them accepting that which was not fit to use. And even those with a fair amount of optimism are frequently inclined to agree.

Too many inspectors start out with the wrong idea of their jobs. They seem to think that their value depends in rejecting as much material as possible, and that the bigger the pile of rejects, the bigger their salaries should be.

In reality, the opposite is true. The best inspector is the man who passes the most parts that can be used with entire satisfaction.

Many times a good inspector is handicapped by fool specifications that were drawn up by someone who didn't know the difference between a micrometer and monkey wrench. It is this breed of bird that puts a tolerance of a half thousandth on an air-fit.

It is no easy job to write even a simple specification. Even a practical man has his hands full to make it say what he means, so that a good inspector can interpret it with a fair amount of sanity. And a fool inspector can make even a good specification appear ridiculous. When you combine a d.f. inspector and a specification of the same kind, good work is sure to be rejected and poor work passed.

It is comparatively easy to train people, with even less than average intelligence, to use fixed gages and accept or reject work according to whether it passes or not. But trobule brews immediately when people of this sort have any chance to exercise what we are pleased to call judgment. With adjustable gages, they can play havoc because they do not know the principles of gaging.

Such a case happened awhile ago when several machines were rejected because the bolts holding a flange in place, were loose in the gage. The inspector's ring gages were so adjusted that a standard plug would shake inside it, and he expected the bolts to be snug in the gage and still go in the hole.

Just why he measured the bolts at all is something of a mystery—or would be if he hadn't been the kind of inspector he was. The machines were special and the bolt size played no part at all in proper functioning. As long as the bolts fitted the holes and had nuts that fitted, an eighth of an inch either way was immaterial.

The only plausible theory is that, having found everything else all right, the inspector, feeling that he hadn't done his full duty unless he rejected something, took out the bolts as a last resort. Whether he adjusted the gage or not, no one seems to know. But it was very evidently adjusted by some one of the same caliber. At any rate he was able to throw out his chest and point with pride to having discovered where the diabolical and scheming manufacturer had tried to put something over on the government—and failed, thanks to his watchfulness.

The result was that the department was deprived of the use of the machine until the facts could be shown up in their true light, and the maker was put to the expense of proving the inspector in error.

Ideas from Practical Men

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the machine building industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Fixtures for Slotting and Cutting Flats on Pins

BY NORMAN MOORE

We had to slot quantities of pins on the ends as shown in Fig. 1 at *A*, and being without proper facilities for doing the work, we devised the fixture shown at *B* for use in a lathe.

The body of the fixture was shouldered down as at *C*, and six equidistant slots were cut in the enlarged part.

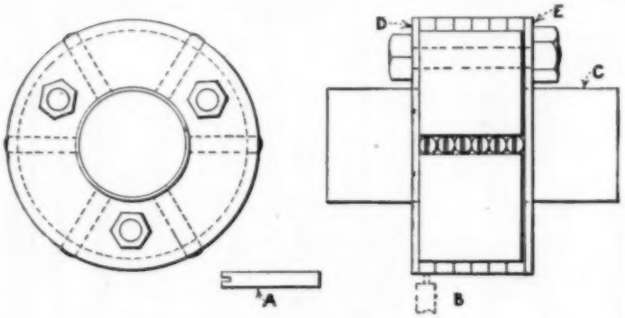


Fig. 1—Fixture for slotting pins

The width of the slots was the same as the diameter of the pins, and the depth was enough less than their length to allow them to protrude somewhat more than the depth of the slots to be cut in them. The length of the enlarged part of the fixture was slightly less than six times the diameter of one pin, since each slot held six pins.

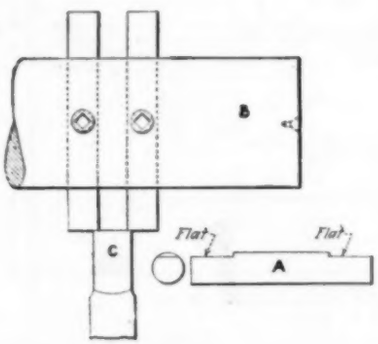


Fig. 2—Fixture for cutting flats on pins

The collar *D* was attached to the fixture by capscrews, the latter passing through and projecting far enough to act as studs for the clamping collar *E* and the nuts with which to tighten it.

To load the fixture, it is turned so that two of the slots are brought above the center, and when they are filled with pins, the nut between the two slots is tightened with the fingers just enough to prevent the pins from falling out when the fixture is revolved. The remaining four slots are loaded, two at a time, in the same manner. When all the slots have been loaded, the three nuts are tightened with a wrench, holding the pins securely.

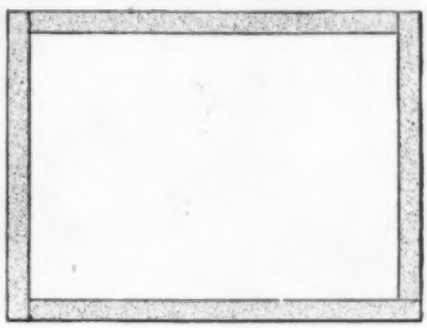
Another lathe fixture, shown in Fig. 2, was devised for holding pins while cutting flats on the sides. There were two flats on each pin as shown at *A*. Holes to accommodate the pins were drilled in the bar *B*, and the pins were held by safety setscrews. A solid, square-nosed tool of the proper width, as at *C*, was fed in as the bar carrying the pins was revolved.

Reinforced Edges for Paper Tracings

BY MARTIN H. BALL

Many drafting departments are finding it economical and quite satisfactory to make a goodly number of drawings on tracing paper instead of tracing cloth, due to the higher cost of tracing cloth, and also to the extra time and cost of making an inked tracing, which is necessary when cloth is used.

The practice described applies to tracings that are not to be used very much, sometimes only once, but which are of sufficient importance as to be kept in the files for an indefinite time. Paper tracings are very difficult to keep flat in the filing cabinet and during the blue printing operation.



Sheet of tracing paper with protected edges

The accompanying illustration shows a way of overcoming these difficulties to a great extent, by pasting a border of paper tape around the edges of the sheets. While the binding can be of whatever width desired from ¼ to 1 in., we have found that a width of ½ in. is desirable in most cases.

The manner of applying the binding is as follows: Draw a pencil line all around the tracing at the point where it is desired to have the inside edge of the border. Moisten the tape thoroughly either by using one of the regular tape-moistening fixtures, or by passing it over a wet sponge. Apply the tape while the sheet is

IDEAS FROM PRACTICAL MEN

stretched taut on the drawing board making sure that the tape is cut somewhat longer than required to reach the length of the drawing, to insure quick work. Delay between the moistening process and the application of the tape will give the tape time to expand and, later when it shrinks back to its original length on the tracing, as it is sure to do, it will cause the tracing to wrinkle.

The plan has been found very helpful in both ease of handling and preservation of the tracings.

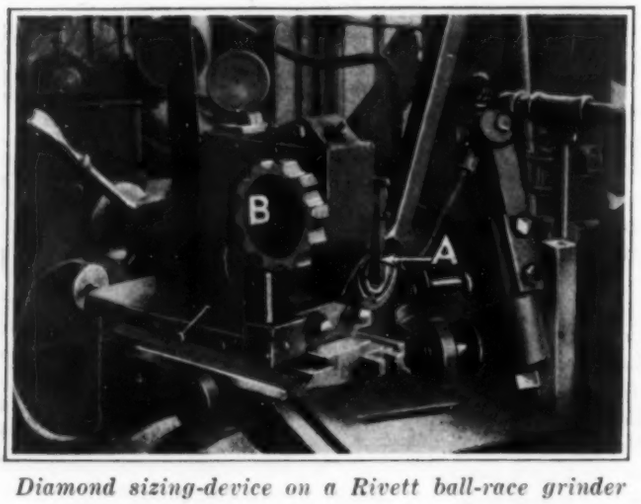
Another kink that is often a great help, and not much extra work on pencil tracings, is to ink in the figures, since they are most likely to be read wrongly on a faint print.

Grinding Ball-Races to Size With the Aid of an Indicator

BY MILTON WRIGHT

A device to enable the operator to keep always under his observation the radius of the ball-race in a thrust bearing ring, while being ground, is shown in the illustration herewith. The device is attached to the oscillating head of a Rivett ball-race grinding machine and swings with it.

The lever *A* has at its lower end a diamond inset, so placed that it may bear upon the bottom of the race being ground, at a point diametrically opposite to the contact of the wheel. The diamond may rest under light spring tension upon the surface being ground, or it may be drawn back by means of the notched wheel *B*, and supported indefinitely out of contact with the work.



Diamond sizing-device on a Rivett ball-race grinder

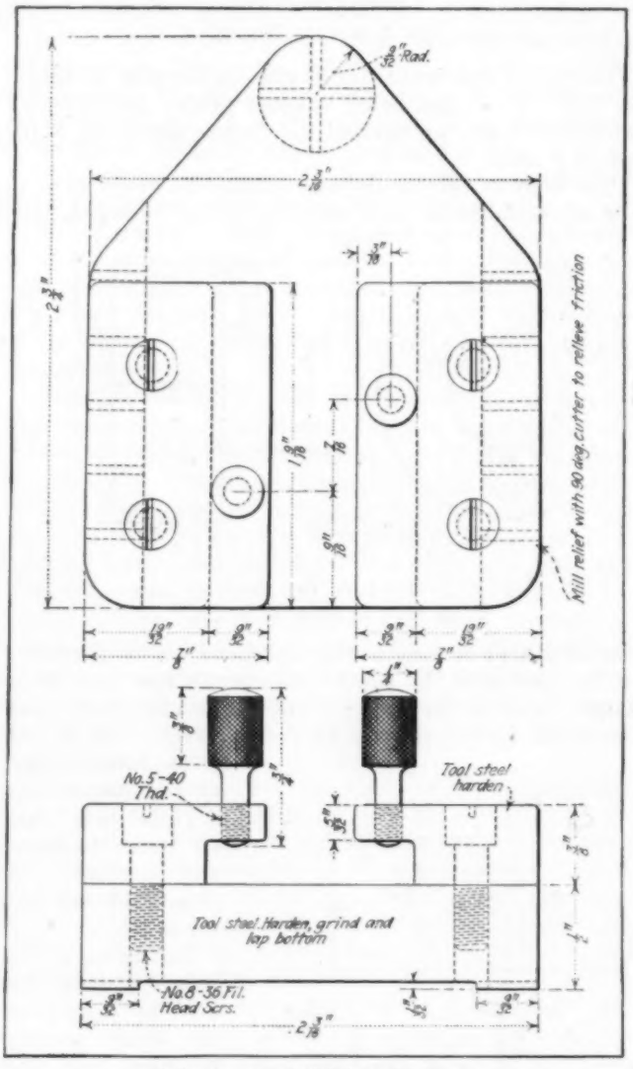
Through a system of multiplying levers the first lever communicates its movement to the pointer of a large dial indicator. The multiplication is so calculated that a movement of 0.0001 in. at the diamond will be indicated as 0.001 in. by the pointer of the gage.

When an unground piece of work is set into the chuck of the machine, the diamond is kept out of contact with it until the wheel has produced a true and smooth surface. The operator then turns the wheel *B* until the lever is released and the diamond bears in the bottom of the groove. The number of thousandths from zero indicated by the pointer of the gage, represents the number of "tenths" remaining to be removed from the radius of the race, and when zero is reached—the indicator having been set previously—the operator knows that the piece is finished.

Adapter to Hold Height Gage

BY JOHN C. ALQUIST

The accompanying sketch is a layout of a very useful adapter to be attached to the bottom of any height gage. Its use prevents the gage from falling over when left alone, and when using the gage to get extreme



Adapter to hold height gage

measurements it is not necessary to hold it down with one hand while the other hand is engaged in manipulating the vernier at its extreme height, since the base is both large enough and heavy enough to support the gage steadily under such conditions.

The two guide plates can be made to suit the bases of any of the gages now on the market, though the dimensions of those given in the sketch are for the gage as made by Brown & Sharpe.

Punch here to suit your binder

Sizes of Standard Milling Cutters (Simplified Practice)

Spiral-Cut End Mills with Morse Taper Shanks

[These end mills are regularly furnished right hand. Left-hand end mills are special]

Diameter	Number of Taper	Length of Cut	Whole Length	Diameter	Number of Taper	Length of Cut	Whole Length
1/4	1	11/16	3 5/16	3/4	2	1 5/8	5 1/8
5/16	1	11/16	3 11/16	3/4	3	1 5/8	5 1/16
3/8	1	7/8	3 11/16	7/8	2	1 3/4	5 1/4
7/16	1	7/8	3 3/4	7/8	3	1 3/4	6 1/16
1/2	2	1	4 1/2	1	2	1 7/8	5 5/8
1/2	1	1	3 11/16	1	3	1 7/8	6 1/16
1/2	2	1 1/8	4 5/8	1 1/8	3	2	6 1/16
5/8	2	1 1/2	5	1 1/4	3	2	6 1/16

Spiral-Cut End Mills with Brown & Sharpe Taper Shanks

[These end mills are regularly furnished either right or left hand]

Diameter	Number of Taper	Length of Cut	Whole Length	Diameter	Number of Taper	Length of Cut	Whole Length
1/4	4	11/16	2 7/16	3/4	7	1 5/8	5 5/8
1/4	5	11/16	3	3/4	9	1 5/8	6 7/8
5/16	4	7/8	2 1/2	7/8	7	1 3/4	5 3/4
5/16	5	7/8	3 1/16	7/8	9	1 3/4	7
3/8	4	7/8	2 1/2	1	7	1 7/8	5 7/8
3/8	5	7/8	3 1/16	1	9	1 7/8	7 1/8
7/16	4	11/16	2 5/8	1 1/8	7	2	6
7/16	5	11/16	3 3/8	1 1/8	9	2	7 1/4
1/2	5	1	3 5/16	1 1/4	7	2	6
1/2	7	1 1/8	5 1/8	1 1/4	9	2	7 1/4
9/16	5	1 1/16	3 1/4	1 3/8	9	2 1/8	7 3/8
9/16	7	1 1/4	5 1/4	1 1/2	9	2 1/4	7 1/2
5/8	5	1 1/4	3 7/16	1 5/8	9	2 3/8	7 5/8
5/8	7	1 1/2	5 1/2	1 3/4	9	2 1/2	7 3/4
11/16	7	1 1/2	5 1/2				

Coarse-Tooth, Spiral-Cut End Mills with Brown & Sharpe Taper Shanks

[Carbon-steel, coarse-tooth end mills are special. These end mills will be regularly furnished in either right or left hand. End mills with tapped holes for drawback spindles are special]

Diameter	Number of Taper	Length of Cut	Whole Length	Diameter	Number of Taper	Length of Cut	Whole Length
1/4	4	11/16	2 7/16	7/8	7	1 3/4	5 3/4
1/4	5	11/16	3	7/8	9	1 3/4	7
5/16	4	7/8	2 1/2	1	7	1 7/8	5 7/8
5/16	5	7/8	3 1/16	1	9	1 7/8	7 1/8
3/8	4	7/8	2 1/2	1 1/8	7	2	6
3/8	5	7/8	3 1/16	1 1/8	9	2	7 1/4
7/16	5	11/16	3 1/8	1 1/4	7	2	6
1/2	5	1	3 5/16	1 1/4	9	2	7 1/4
1/2	7	1 1/8	5 1/8	1 3/8	9	2 1/8	7 3/8
9/16	7	1 1/2	5 1/2	1 1/2	9	2 1/4	7 1/2
3/4	7	1 5/8	5 5/8	1 5/8	9	2 3/8	7 5/8
3/4	9	1 5/8	6 7/8	1 3/4	9	2 1/2	7 3/4

Straight-Shank End Mills

[These end mills are regularly furnished either right or left hand. Straight-shank end mills under three-eighths inch diameter have straight teeth; three-eighths inch diameter and over have spiral teeth]

Diameter	Length of Cut	Length Overall	Diameter	Length of Cut	Length Overall
1/8	5/16	1 1/4	3/8	11/16	2
5/32	5/16	1 1/4	7/16	1/2	2 1/8
1/16	5/16	1 1/2	1/2	11/16	2 1/4
11/64	5/16	1 1/2	9/16	11/16	2 5/16
3/16	5/16	1 7/8	5/8	3/4	2 5/8
1/4	1/4	1 7/8	11/16	3/4	2 11/16

Straight-Cut End Mills with Morse Taper Shanks

[These end mills are furnished regularly in right hand. Left-hand end mills are special]

Diameter	Number of Taper	Length of Cut	Whole Length	Diameter	Number of Taper	Length of Cut	Whole Length
1/4	1	11/16	3 5/8	5/8	2	1 1/2	5
5/16	1	7/8	3 11/16	3/4	2	1 5/8	5 1/8
3/8	1	7/8	3 11/16	3/4	3	1 5/8	5 1/16
7/16	1	11/16	3 3/4	7/8	2	1 3/4	5 1/4
7/16	2	1	4 1/2	7/8	3	1 3/4	6 1/16
1/2	1	1	3 11/16	1	2	1 7/8	5 5/8
1/2	2	1 1/8	4 5/8	1	3	1 7/8	6 1/16

Straight-Cut End Mills with Brown & Sharpe Taper Shanks

[These end mills are regularly furnished in either right or left hand]

Diameter	Number of Taper	Length of Cut	Whole Length	Diameter	Number of Taper	Length of Cut	Whole Length
1/4	4	11/16	2 7/16	1/2	7	1 1/8	5 1/8
1/4	5	11/16	3	5/8	5	1 1/4	3 7/16
5/16	4	7/8	2 1/2	5/8	7	1 1/2	5 1/2
5/16	5	7/8	3 1/16	3/4	7	1 5/8	5 5/8
3/8	4	7/8	2 1/2	7/8	7	1 3/4	5 3/4
3/8	5	7/8	3 1/16	1	7	1 7/8	5 7/8
7/16	4	11/16	2 9/16	1 1/8	9	2	7 1/4
7/16	5	11/16	3 1/16	1 1/4	9	2	7 1/4
1/2	5	1	3 5/16				

Slotting End-Mills, Two-Lipped, with Brown & Sharpe Taper Shanks

[These cotter mills are regularly furnished either right or left hand and with straight flutes. Two-lipped cotter mills with spiral flutes are special]

Diameter	Number of Taper	Length of Cut	Whole Length	Diameter	Number of Taper	Length of Cut	Whole Length
1/4	4	3/8	2	11/16	7	1 1/32	5 1/32
1/4	5	3/8	2 1/2	3/4	7	1 1/8	5 1/8
1/4	7	3/8	4 3/16	11/16	7	1 1/32	5 1/32
5/16	5	11/32	2 11/16	7/8	7	1 1/16	5 1/16
5/16	7	11/32	4 11/16	7/8	9	1 1/16	6 1/16
3/8	7	9/16	4 5/16	1	9	1 1/2	6 1/4
7/16	7	11/32	4 11/32	1 1/16	9	1 11/16	6 11/16
1/2	7	3/4	4 3/4	1 1/4	9	1 7/8	7 1/16
9/16	7	11/32	4 11/32	1 1/2	9	2 1/4	7 1/2
5/8	7	11/16	4 11/16				

(To be continued)

Punch here to suit your binder

Trim Line

Practical Shop Problems

Questions of a Practical Nature will be answered in these Columns

Making a High-Pressure Pipe Joint

Q. Please advise us how to make a serviceable joint between two lengths of 8-in. pipe to carry 1,000 lb. of hydraulic pressure without resorting to special connectors and by using metal instead of other materials as a packing. We do not desire to weld.

A. A good way to make such a joint is to thread the ends of the pipes for flanges so they can be screwed back enough to leave ⅛ to ¼ in. of pipe projecting beyond their faces. The ends of the pipe should be machined square in a pipe machine or by other means but the ends should not be filed under any condition. The pipe which of course will be double-extra heavy will be approximately ¾ in. across this flat face.

A gasket should then be cut from a copper sheet that is approximately 1/16 in. in thickness and of diameter equal to the outside of the pipe. A tail, left on, will assist in placing it. The copper should be heated and quenched to render it soft before it is placed in position. The pipes are then butted together and the flange volts drawn snug. It is important that they be drawn up evenly all around. Finally the bolts are set hard and a butt joint has been made that will last indefinitely. Be certain there is a hole through the gasket before it is placed in position.

File marks or scratches across the pipe ends or the gasket are sufficient to allow a leak, at this pressure, which will be ruinous to the joint. Properly made, however, this joint is an excellent one for hydraulic pressures far in excess of the 1,000 pounds.

Aligning a Wormwheel Drive

Q. We have, at times, had considerable trouble with a worm and wormwheel assembly that is part of a drive made in quantities. The wormwheel is roughly 9 in., and the worm measures 1 in. pitch diameter. The former is of cast iron and the latter of steel.

The trouble lies in misalignment between wormwheel and worm as to axial errors in the wheel causing it to wobble slightly and as to lateral alignment causing the worm to bear to one side of the wormwheel center line.

The trouble seems to be due to inability to eliminate slight inaccuracies in drilling and pinning the wormwheel in place and drilling the shaft centers in the case slightly out of line. The result is a noisy assembly and a cutting action between worm and wormwheel which causes rejection of whole assemblies, but not until all the work prior to assembly is completed at a considerable cost.

We have conceived the idea of using a special hob to cut the wormwheel teeth so they will be a part of a circle of larger radius than the worm. This would allow for the irregularities we have mentioned but we desire your advice before proceeding.

A. We believe, all things considered, that there are better ways of obtaining satisfactory assemblies than by making any changes in the teeth from standard.

We gather from your description that the teeth are being cut before the wormwheel blank is fitted and drilled for its shaft mounting. We suggest that you make the hobbing operation last and that you look into the possibility of providing a flange on the wormwheel shaft against which the wormwheel can be registered. The arbor on which the wheel is mounted for hobbing should be an exact duplicate of this shaft, or the shaft itself, if this is possible.

The addition of the flange on the shaft could also be used to advantage in correcting for side alignment with the worm by making provision for placing shims between the flange and the wormwheel at final assembly.

In short we believe that making a special tooth on the worm would amount to taking a wrong step to correct another wrong, a dangerous practice.

Heat Distribution Under a Soda-Melting Tank

Q. We have a caustic soda installation consisting of a tank, in which the soda is melted, and a furnace, located at one end, arranged to burn pea coal to supply the necessary heat. The tank measures 24 in. in width, 6 ft. in length, and 8 in. in depth. It is made of 1/16-in. steel plate.

The products of combustion pass under a short arch above the furnace and then directly under one end of the tank from where they pass along the bottom of the tank to a flue at the other end.

The tank burns through at the bottom near the furnace in a very short time and we are asking you to tell us what may be the trouble.

A. The trouble is due to an uneven distribution under the tank and a concentration of heat where combustion is completed just as the gases leave the furnace. It is possible to remedy the condition by constructing an arch under the tank at this hot spot, providing the space is not too limited, that will act to protect the steel at this point. There will still be an uneven distribution of heat, however, and a better plan would be to reset the tank so there will be a false arch under the entire length that will constitute a passage for the gases to the end opposite the furnace, the arch to be set away from the bottom so the heat can return again under the length of the tank above the arch and emerge at the furnace end.

Still another method, and we believe this would be the best, would constitute an arrangement of furnace at one side of the tank centrally between the ends. There should then be an arch under the tank and side outlets at both sides to flues at both ends. The arch would assist in completing combustion and with dampers in both outlets the heat distribution could be maintained evenly.

Technical Abstracts

Time Study

The technique of making time and motion studies has been developed during the last few years to an accurate science. The late Frank Gilbreth emphasized time and motion study as the means of determining "the one best way" in performing an operation, basing his studies on the best worker available and determining the ideal time. Mr. Gilbreth discarded the stop watch altogether and used an apparatus which consisted of a moving picture camera, a clock, slates with records and a background ruled into squares. The film showed the operation to be timed, and the equipment. So far, time and motion study appear to be limited to the metal industry, but the textile, shoe, box-making and other industries are just beginning to realize the tremendous value of job analysis and standardization through time and motion study. A new field is opened to the time-study engineer in the standardizations of activities in construction work, offices, warehouses, jobbing houses and general business enterprises. Incentive systems of wage compensation based on time and motion-study standards have been in successful operation for a number of years.—*American Management Review*, Nov., 1925, p. 337.

Good Lighting

A. G. Anderson, research engineer in industrial management, University of Illinois, states that of 445 plants studied in a recent survey made by the American Engineering Council, only 8.7 per cent were found to be excellently lighted; 32 per cent were graded as good, 29.1 per cent, fair; 18.8 per cent, poor; 3.5 per cent, very poor; and 7.8 per cent, partly good and partly fair. In spite of the fact that the modern industrial worker often accomplishes more with his eyes than with his hands, and that 25,000,000 of the 40,000,000 gainfully employed men and women suffer from defective vision, over 90 per cent of the manufacturing plants of the country, if the above survey is typical, still neglect one of the first and most important requisites for profitable production.

The factory manager is impelled toward good lighting because of its immediate practical effects; such as: First, reduction of accidents; second, greater accuracy in workmanship; third and fourth, increased production at a lower cost; fifth, less eye strain; sixth, better working and living conditions; seventh, greater contentment of the workmen and less labor turnover; eighth, better order, cleanliness and neatness in the plant; ninth, easier supervision of the men.—*Management in Manufacturing*, Nov., 1925, p. 277.

Welding Reduced the Junk Pile

Any measurement of the saving to industry through the use of welding must take into account the fact that frequently this is the only means by which an expensive piece of machinery could be repaired and put back into service. Again, the welding of a broken part or machine may mean the prevention of a great loss in production which might otherwise fall upon an industry if it had been necessary to shut down a plant, even in part, to await the arrival of new equipment.

Although a machine may have suffered serious damage, it has been repeatedly demonstrated that it could be so well repaired by an experienced welding operator that when ready for service it was in as good condition as the day it was newly purchased. That welding properly done will stand the test of time and hard usage has been proven countless times on a great variety of jobs. An instance which is typical is afforded in the case of a repair job made six years ago on a huge air compressor. The equipment had been broken in six pieces and seemed about ready for the junk heap. Not only were the six pieces welded into a homogeneous unit, but the job was so well done that the compressor has been successfully operating day in and day out ever since.

In modern buildings of today one may see instances of girders, joists, and what not, where welding has replaced the rivet. In machinery plants the same condition is to be found—the rivet is going and the weld is taking its place.—*Industry Illustrated*, Nov., 1925, p. 46.

Selecting Equipment

The actual methods used in selecting new equipment vary somewhat in different automobile plants. In one plant the equipment engineer studies every opportunity for increasing production or reducing cost that comes to his attention, either through his own observations or through suggestions from the production staff. He makes a thorough investigation, and after he has made up his own mind as to what equipment ought to be purchased and formulated his reasons for the purchase, he reports to the works manager who signs the order for the equipment after he has satisfied himself that the machines selected are the best for the purpose. The equipment engineer never recommends any equipment without first consulting the foreman of the department where the machines are to be used. He explains to the foreman the reasons why certain machines should be bought. Sometimes the foreman offers objections and if these appear to be valid the equipment engineer changes his recommendations.

Calculations are based upon the estimated number of cars that will be built during the period in question, and the saving per car is estimated. Then the number of production days required to effect a saving that will offset the cost of the new equipment is calculated. In making this estimate, all costs are thoroughly considered, including the overhead, the cost of tools, the grinding of tools, the cost of grinding wheels and the cost of dressing the wheels. There are cases on record where new equipment has paid for itself in twenty-two working days. Equipment paying for itself in from 100 to 200 working days is not unusual. In one case, equipment costing $12,000 paid for itself in less than three months.—*Machinery*, Nov., 1925, p. 184.

American Machinist

Established 1877

KENNETH H. CONDIT AND FRED H. COLVIN, *Editors*

The Consensus of Opinion

SOME laws are easy to administer—others impossible. Why? Writing in the "Nation's Business," Dr. P. G. Agnew, secretary of the American Engineering Standards Committee, points out that a law that truly represents a consensus of public opinion can be enforced without much difficulty. On the other hand, a law that has been pushed through by an organized minority by reason of the general apathy of those not particularly interested is a constant source of trouble to the constituted authorities.

Business men, sick of the costly and generally needless delays of the common and statute law, have set up arbitration machinery to settle their differences in an expeditious way. Industry, many of whose problems cannot be solved by resort to law because action by the legislatures of forty-eight states is involved, is rapidly learning to get the various interested parties together and thus reach relatively quick solutions.

Few people realize the extent of the progress made in reducing the numbers of sizes and styles of many products through the work of the Simplified Practice Division of the Department of Commerce. Great advances have also been made in standardization, safety codes and specifications by the engineering societies and trade associations through the American Engineering Standards Committee which acts as a clearing house.

This self-policing of business and industry, as Dr. Agnew calls it, is a recent development, most of it dating from the period of the world war or later. Yet it promises to have a pronounced effect in reducing the appalling flood of new laws that descends on the community every time a legislature meets. It is unqualifiedly a move in the right direction.

The President's Message

ALMOST universal satisfaction has been expressed with President Coolidge's message to Congress just convened. Of most interest to industry, probably, are the statements that deflation in war-engendered government expense has been practically completed; that the general condition of the country is one of progress and prosperity; that surplus war materials have been disposed of; that the new tax measure framed by the House Ways and Means Committee, and especially its non-partisan aspect, meets with administration approval. The sections urging further railroad consolidation under the supervision of the Interstate Commerce Commission and an extension of the practice of settling industrial difficulties by means of conference, conciliation and arbitration merit approval.

Now, if Congress will accept the President's suggestions and proceed expeditiously to put them into effect, it will do much to erase the very bad impression made on the country as a whole by its predecessor.

We Trail the World in Research

IT IS perhaps natural that we should think of research as being confined to some particular industry or industries that would benefit directly by any discoveries made. That such a view is narrow and not likely to be of the greatest benefit to us as a nation, is the view of no less an authority than Secretary Hoover. And Mr. Hoover can hardly be accused of being idealistic or theoretical to the exclusion of practicality.

In his address on Economics and Engineering at the recent A.S.M.E meeting, Mr. Hoover stated that in matters of pure research we were far behind the rest of the world when, with our position, resources and wealth, we should be first. In his opinion, the work of Faraday, Maxwell, Hertz and others in the realm of pure science, was of far more value to the world than many of the modern activities in which men have accumulated vast fortunes.

It seems evident that we must first cultivate an appreciation of the value of scientific research. For with a true appreciation of its worth, we can be counted on to provide means for its development.

Commercial Aviation Is Growing

ALTHOUGH the growth of commercial aviation is still handicapped by lack of laws regulating the licensing of pilots and the inspection of planes, it is growing faster than most of us realize. Not by the operation of large airplane routes but by more and more concerns using one or more planes in a business way. Those who are building planes, instruments and accessories report a steady growth of business from commercial sources.

The development of aviation not only affects builders of plane and direct accessories but also such apparatus as lighting equipment for landing fields, which of itself is quite an item. Land lighthouses for night flying and flood lights for landing fields are important items, both for the safety of the flyers and as a line of manufacture that is assuming larger proportions every year. Commercial aviation is here and is growing in spite of handicaps.

Shop Equipment News

Kent Six-Spindle Drilling Machine

The Kent Machine Co., Kent, Ohio, is manufacturing the semi-automatic, six-spindle drilling machine, illustrated in Figs. 1 and 2, for motor and belt drive, respectively. The machine is designed with standard fixtures for drilling holes in bolts, pins and other circular or hexagonal pieces, six at a time.

There are 12 work-holding fixtures set in a row in front of the spindle and spaced so that alternate ones are in working position. A clamp is operated on each by an individual lever which rocks in a recess in a stationary plate on the front of the bed. Six clamps are loose at a given position of the table carrying the fixtures. When the table is shifted endwise to bring the six previously idle fixtures into line with the spindles, the clamping arrangement is automatically reversed.

The table carrying the fixtures is moved to the drill spindles by means of a cam and camshaft. The cam is designed so the movement of the table is rapid up to the point where the drilling begins when it is retarded to the proper feed for the work in hand. A quick-return mechanism is used to withdraw the table after the work has been completed.

This quick-return mechanism is designed so that any portion of the camshaft from 20 to 120 deg. can be used. This enables the speed of the return to be adjusted so that the operator will have sufficient amount of time for loading and unloading. The mechanism is adjusted by changing the location of two dogs which are on a revolving disk at the end of the machine. A set of change gears is furnished with the machine so that any desired speed and feed of the drills can be obtained.

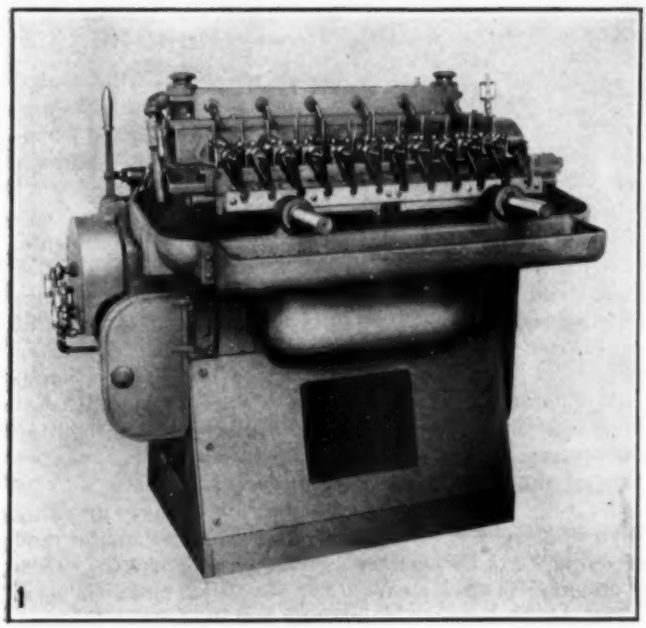
The spindles are driven by a single horizontal shaft upon which are mounted special heat-treated driving gears to engage with similar gears on the drill spindles. The drill spindles are of heat-treated steel. They run in hardened and ground tool steel bearings.

In order to lubricate the bearings and gears in the spindle-driving box, the oil is forced to the top of the box by means of a centrifugal pump. The oil is collected on a shelf in the box and overflowing from there floods the gears. Individual delivery pipes from the shelf carry the oil to the bearings. An indicator at the rear of the machine has the recommended oil level marked on it and the operator can see the proper amount of lubricant through a glass sight. Other working parts of the machine are lubricated through sight-feed oil cups and ball oilers.

A continuous supply of coolant is furnished to the drill spindles by means of a chain-driven pump located below and to the rear of the pan under the machine. This pan is provided with an adequate strainer to keep the coolant clean.

A tool box is provided in the leg of the belt-driven machine for wrenches and change gears. This tool box is also furnished in the base of the motor-driven machine at the end opposite to the motor. The base of the motor-driven machine is ventilated.

The spiral gears used in driving the drill spindles are ground and have been designed so that the thrust



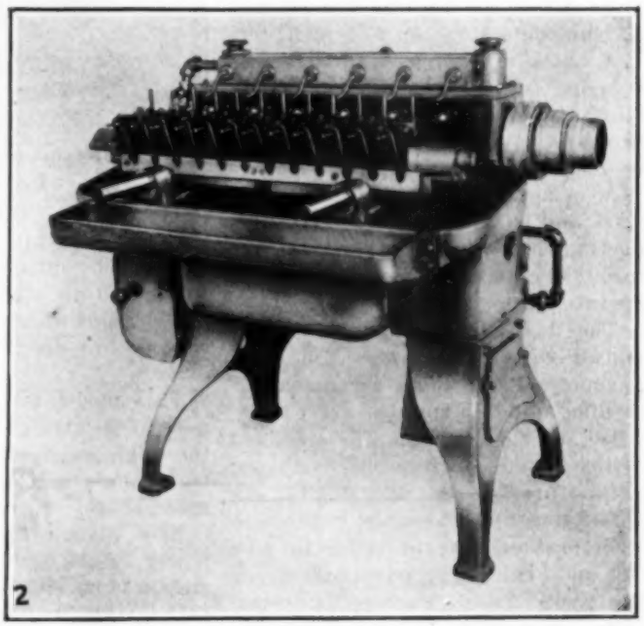


Fig. 1—Kent Six-Spindle Drilling Machine with Motor Drive. Fig. 2—Belt-driven model

SHOP EQUIPMENT NEWS

is in the same direction as that of the drilling and is taken by a roller thrust bearing. All indexing gears and the roller clutch are made from alloy steel, hardened and ground. The worm-gear ring is of phosphor-bronze, and runs with a tool steel worm. The lead cams for operating the table are made from steel and are pack-hardened. These can be furnished in all sizes from $\frac{1}{16}$- to 1-in. stroke, varying by amounts of $\frac{1}{16}$ in. and can be readily changed. The feed table is adjustable to accommodate special fixtures and can be moved in and out by means of a screw rather than the cams if desired.

The machine has a capacity for drills between $\frac{1}{64}$ and $\frac{1}{4}$ in. The standard fixtures will accommodate either round or hexagonal stock of from $\frac{1}{16}$ to $\frac{3}{4}$ in. Special fixtures will accommodate stock up to 1 inch.

A quick unloading fixture can be supplied for the machine, by which all six fixtures are unloaded simultaneously, leaving only the loading to be done by the operator. The fixture is applicable to certain headed work and is said to increase the production by a considerable amount through cutting the time between operations.

The belt-driven machine is designed with a three-step cone and a countershaft. The recommended drilling-spindle speeds are 1,500, 1,950 and 2,600 r.p.m. The standard motor-driven machine is furnished with three sets of silent-chain sprockets to be used in connection with one machine in order to give the same spindle speeds as those for the belt-driven machine. Special sprockets can be furnished for the motor-driven drill to give spindle speeds of 2,200 and 2,900 revolutions per minute.

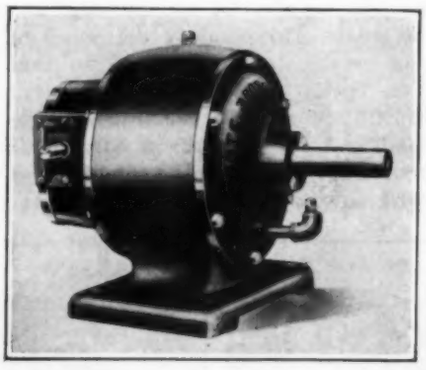
The base of the machine is designed to accommodate a 2-hp. 1,800-r.p.m. motor. The angle plate for holding the motor is clamped to the leg by four bolts and is adjustable by means of a screw, in order to accommodate the different center distances required for the different spindle-speed sets.

The machine is somewhat similar to a six-spindle drill formerly manufactured by the National Acme Co., Cleveland, Ohio, and from whom the manufacturing rights were purchased by the Kent Machine Co.

Foote Right-Angle-Drive Spur Reducer

The Foote Bros. Gear & Machine Co., 242-252 North Curtis St., Chicago, Ill., has placed on the market the right-angle-drive spur reducer, illustrated. This reducer is an addition to the IXL line, one model of which was described on page 657, Vol. 45 of the *American Machinist*.

The unit is designed to meet the requirements for reduction gears



Foote Right-Angle-Drive Spur Reducer

that must operate in confined spaces, where sufficient room is not available for mounting standard straight-line models, and where it is necessary to change the direction of the power drive.

This model is similar in appearance to the straight-line reducers but the high-speed shaft projects at a right angle to the axis of the slow-speed shaft.

The change in direction of the power drive is accomplished by means of bevel gears mounted in the high-speed end. The secondary bevel, or miter gear, is mounted on the high-speed driving shaft which is concentric with the slow-speed shaft.

The design of the machine is identical with that of the standard, IXL, non-planetary, spur-gear reducer except for the addition of the bevel gears. The high-speed pinion is integral with its shaft and delivers the power through three idler gears set at 120 deg. about the axis to a large internal gear. This internal gear is secured to the slow-speed shaft. For greater reductions the combination can be repeated.

The pinions and bevel gears can be changed in order to obtain a desired speed ratio. Sets have been produced with ratios up to 350 to 1 in sizes up to 150 horsepower.

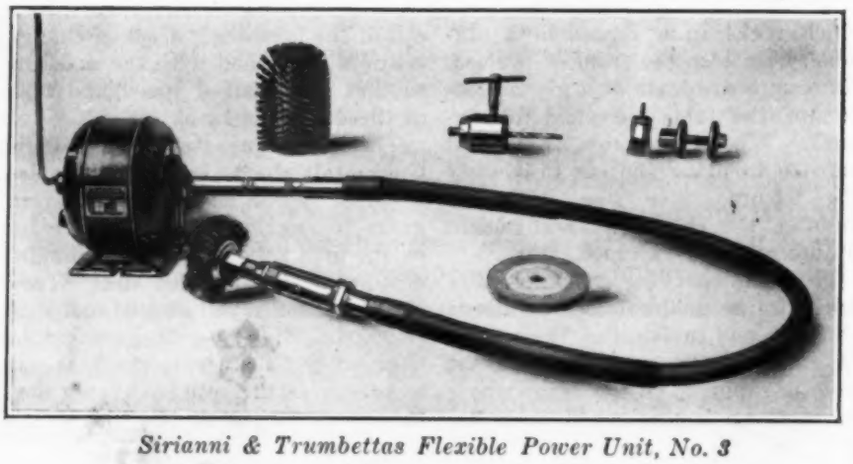
Sirianni & Trumbettas Flexible Power Unit, No. 3

The flexible power unit illustrated is the No. 3 of a line of similar equipment made by the Sirianni & Trumbettas Manufacturing Co., 6 Brown St., Carbondale, Pa.

The equipment consists of a motor, a flexible shaft and attachments, including brushes, a grinder, a buffer and a drill. All the attachments are interchangeable and will fit any of the company's machines.

The shaft is fitted with a handpiece that is equipped with ball bearings in order to obviate the heating tendency in plain bearings. The core is $\frac{1}{2}$ in. in diameter.

The machine will take grinding wheels up to 8 in. in diameter and can operate at speeds up to 10,000 r.p.m. A $\frac{1}{4}$- or $\frac{1}{3}$-hp. motor is used to drive the No. 3 shaft, but other sizes up to 5 hp. can be furnished.

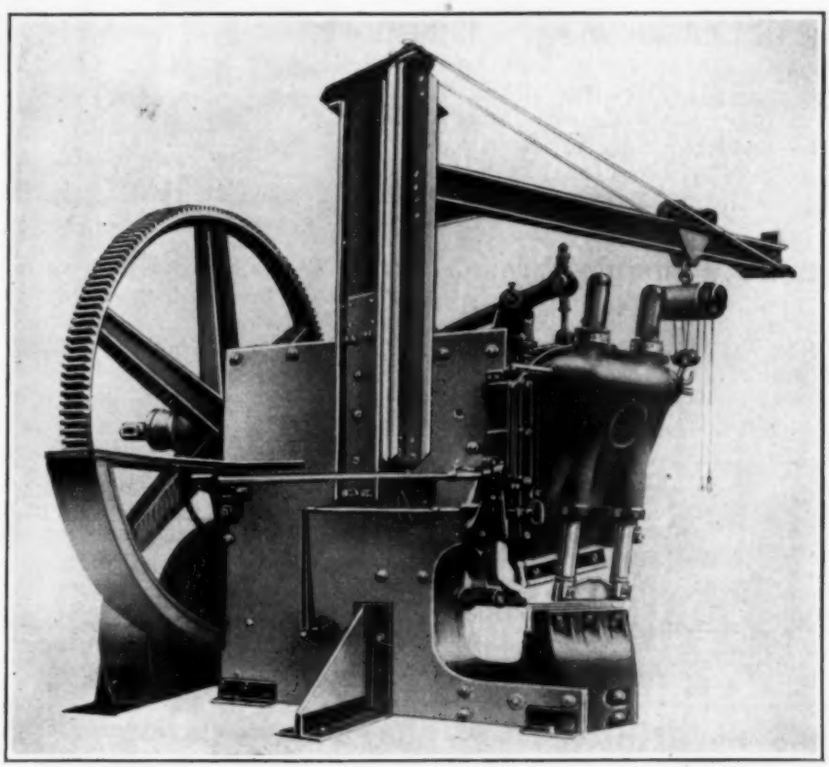


Sirianni & Trumbettas Flexible Power Unit, No. 3

SHOP EQUIPMENT NEWS

Pels Scrap and Plate Shear, Heavy-Duty Type-SS

The type-SS, heavy-duty, scrap and plate shear has been added to the line of Henry Pels & Co., 90 West St., New York, N. Y. There is a line of machines built in seven sizes with capacities ranging from 60 to 480 tons, continuous shearing pressure. The No. 45, a 330-ton machine, is illustrated. It is particularly suitable for use in yards where ships are being broken up.



Pels Scrap and Plate Shear, Heavy-Duty, Type-SS

The frame of the machine consists of armor plates with a cast-steel distance piece placed between them and carrying the cast-steel shear slide. The slide is balanced by means of counterweights and springs and moves in long, adjustable, box-guides heavily bronze lined. An improved stop motion is provided consisting of a claw clutch that automatically disengages after each stroke at the top of the stroke. A locking arrangement provides for continuous shearing.

All the type-SS shears are equipped with downholders which can be adjusted to suit any thickness of material, by means of a handwheel and threaded spindle. The downholders on the Nos. 45 and 55 are worked automatically from the flywheel shaft by means of a cardan shaft and bevel gearing.

The shear blades are set diagonally to the body of the machine so that bars can be cross-cut to any length. The upper and lower shear blades are interchangeable and reversible.

A safety shear-pin, attached to the Nos. 28 and heavier shears, is designed for a safe pressure limit. In these cases the flywheel is connected to its shaft by means of a coupling plate that automatically shears off the pin in case of overloads. This device lessens the chances of serious damage to vital parts of the machines, such as the gear wheels.

The pinions and the shafts are of forged steel, heat-treated and the shafts are ground. Sheet-steel safety guards are provided over the gears.

The No. 45 shear has an effective throat gap of 24 in. Its capacity for shearing with the same blades at one stroke, is flats 22x2 in., rounds 4 in. in diameter and also 3⅝-in. squares. It will cut plates up to 1¾ in. thickness, pipes up to 12¼ in. in diameter and up to 120-lb. rails.

A 35-hp. motor is required to drive the machine. The flywheel is 79 in. in diameter and it turns at 200 r.p.m. to operate the shear at 14 strokes per minute. The length of the shear blades is 30 inches.

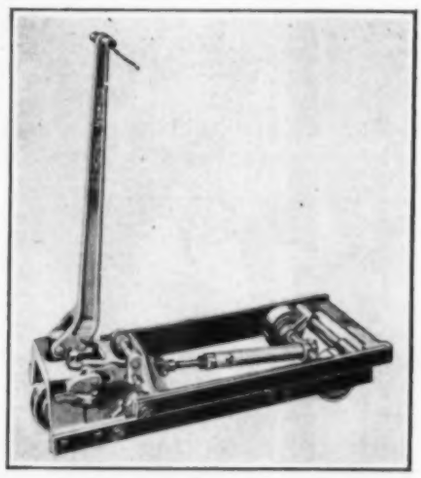
The floor space required is 191x134 in. The height above the floor is 152 in. and the weight, 58,300 pounds.

Cowan Lift Truck, Light-Duty, "Blue Streak"

The Cowan Truck Co., Holyoke, Mass., has developed a line of light-duty, hand lift-trucks that are being marketed under the name of the "Blue Streak" or type "L" trucks.

The type "L" truck retains all of the general features of the type "G" or "Red Devil" line previously described on page 1122, Vol. 48 of the *American Machinist*, but it is lighter in construction and is intended to supplement the heavier line.

The trucks are made in two types, the low-lift and high-lift for raising platforms a distance of 1⅛ and 2¾ in. respectively. There are 16 sizes in the line, having 3 or 4 wheels 6, 7 or 9 in. in diameter as desired, and designed for platforms from 17x32 in. to 25 x 48 inches.



Cowan Lift Truck, Light-Duty, "Blue Streak"

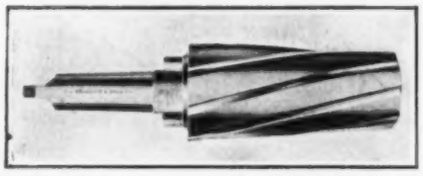
The truck is rated at 2,000-lb. capacity, is alemite lubricated, and has roller bearing wheels. A positive-release check and a lifting device is provided.

SHOP EQUIPMENT NEWS

Brubaker Spiral Inserted-Blade Reamers, High-Speed

The W. L. Brubaker & Bros. Co., 50 Church St., New York, N. Y., have brought out a line of spiral-fluted reamers in which high-speed inserted blades are used.

The blades are made of heat-treated steel and it is claimed that the assembly has the qualities of a solid-blade reamer at a lower cost.

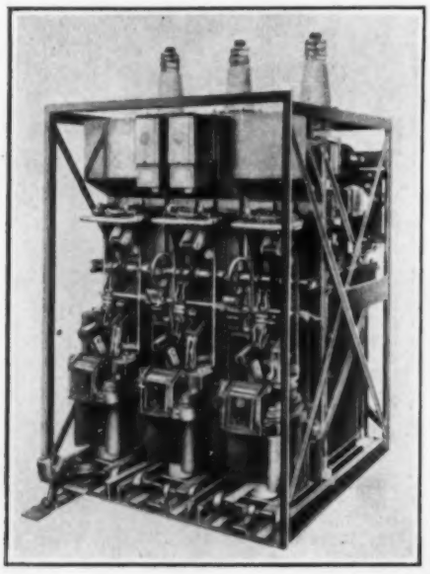


Brubaker Spiral Inserted-Blade Reamers, High-Speed

The company is prepared to replace new blades in old reamers when the original set wears out. The reamers can be made in any taper and in sizes above 3 inches.

General Electric Circuit-Breaker Housing Framework

The "ready-to-use" housing framework, illustrated, is being manufactured by the General Electric Co., Schenectady, N. Y., to enable the installation of its type FK-54 oil circuit breakers with a minimum amount of skilled work.



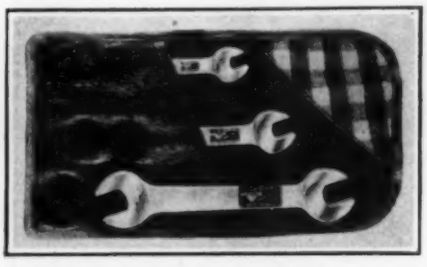
General Electric Circuit-Breaker Housing Framework

The three runways of the framework are welded in one piece, forming a base plate to which is welded an overhead structure made up of angles and steel straps. To install the equipment it is necessary only to run the housing into the cell, to secure it with grouting through the base plate and to make the usual connections.

The units are interlocked to prevent withdrawal of closed breakers and there is an interlock between tripping coils so that the opening of one unit opens the entire circuit. A grounding device on each breaker gives protection until the main contacts have been separated by a distance of three inches.

Bonney Sample Wrench Kit, No. 1

The Bonney Forge & Tool Works, Allentown, Pa., has placed on the market the No. 1 sample wrench kit, illustrated. The kit contains three



Bonney Sample Wrench Kit, No. 1

double-end engineer's wrenches made from chrome-vanadium steel.

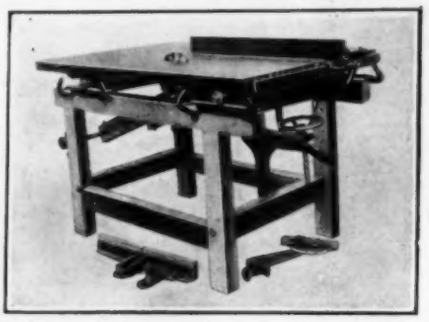
The three tools will accommodate nuts and bolts in sizes of $\frac{7}{16}$, $\frac{1}{2}$, $\frac{9}{16}$, $\frac{5}{8}$, $\frac{3}{4}$ and $\frac{7}{8}$ in. They are contained in a leatherette roll.

Silver Roll-Top Saw Table No. 80

The No. 80 roll-top saw table, illustrated, is being produced by the Silver Manufacturing Co., Salem, Ohio, and is intended for accurate as well as for heavy duty.

The frame is constructed of seasoned maple with the joints mortised, tenoned and bolted. The saw arbor is mounted on a frame and supported by bearings at the rear of the saw. It is adjusted, from in front of the machine, through a slotted quadrant by means of a handwheel. The table has a removable throat, the full length of the table, 5 in. wide, which can be removed to enable the use of dado heads on the arbor.

The machine is equipped with ripping, mitering and cut-off gages. When it is used as a cross-cut saw the material travels with the roller



Silver Roll-Top Saw Table, No. 80

table and can be firmly held against the cut-off gage on both sides of the saw.

The size of the table is 35x58 in. and its height is 3 ft. The table travel is 23 in. A 4- to 6-hp. motor is required to drive the machine at speeds of from 2,200 to 3,000 r.p.m., according to the size of the saw used.

The maximum depth of cut possible is 5 in. and the greatest saw diameter is 16 in. The machine weighs 580 pounds.

France Imports Fewer Machine Tools

Comparison of the imports of machine tools into France during the first six months of the years 1924 and 1925 shows a decrease of 720 metric tons during the first half of this year. (Customs statistics are given by weight rather than value in francs, because of fluctuations in exchange.) In that period of the year 1924 Germany, Belgium, Great Britain, the United States and Switzerland ranked in the order named as the principal countries of origin.

Germany, supplying 1,962 metric tons, and the United States, 1,864 metric tons, were the two main sources during the first six months of 1925. The amount from Germany was practically the same as for the January to July period of 1924, while the United States figure represents an increase of 78 per cent. Imports from Great Britain and Belgium declined almost 50 per cent.

Exports of machine tools from France during the first six months of 1925 amounted to 5,057 metric tons, an increase of 701 metric tons over the 4,356 tons exported during the corresponding period of 1924. Belgium, taking 1,554 metric tons from January to July, 1924, and 1,115 metric tons in the same months of 1925, was by far Frances's best customer.

News of the Week

German Engineer Praises American Genius in Development of Machine Industry

Says we are masters in the art of handling our employees

A remarkable tribute to American genius and industry was paid recently by Von Friedrich Muenzinger, noted German engineer, in an address before a meeting of the Society of German Engineers, at Augsburg, Germany. Mr. Muenzinger was discussing the undisputed leadership of America in mechanical engineering, and particularly in the field of power development.

The United States is a very rich country, has had a victorious war, its economic status is on the up trend, the electrical power system has been expanded on a large scale, and throughout the country optimism is dominating, he declared. However, it would be erroneous to conclude that the American progress is based solely on material causes. Spiritual causes have had, no doubt, considerable influence. The American is a master in the handling of employees and workmen and the natural, yet respectful, conduct between superior and employee stands out favorably when compared with the European practice.

This pleasant relationship is facilitated by the fact that the American workman has no class hate and does not regard his superior as his enemy. On the contrary the American worker has the desire to obtain as quick as possible by his ability and education a higher income and tries by all possible means to broaden and deepen his knowledge. This results in an excellent co-operation between employer and employee. Workmen and employees frequently express their pride in belonging to the same known establishment.

But between manufacturer and customer there also exists a good relationship. They help each other mutually and this kind of co-operation seems to be typical of the whole country. It avoids much friction and saves an enormous amount of money and time which we in Germany have to spend in order to avoid this condition.

It seems that almost everyone whether high or low in position, is penetrated by the consciousness of the responsibility of the big task to make America happy and wealthy. Several skillfully edited popular periodicals have made engineering activities, so to speak, common property of the people who take active interest in all its achievements; whereas in Germany a considerable part of the population looks upon the world of machines not exactly disparagingly but patronizingly or even indifferently. The average American, if he is not an engineer himself, is much more conscious of the fact how much his existence is dependent on the results of engineering and the interest of the greater public in engineering features is a strong incentive for workman and engineer.

At home we find even in engineering circles frequently little understanding for the fact that an industrial machine factory cannot flourish and produce efficiently without a reasonable profit. The German tendency to criticize foreign achievements easily overlooks commendable parts and makes shortcomings appear greatly exaggerated. Especially engineers who have never designed or sold themselves make this mistake because they do not know how difficult it is to create something better and to manufacture it with profit which will carry on the enterprise.

The difficult position of the German machine industry is, nevertheless, surprisingly little recognized even by leading engineers. They do not see that good foreign markets are very important for the progress and efficiency of the industry, especially as the home market is weakened by diminished purchasing power.

Americans on the contrary consider it only natural to aid their home industry in every way and their willingness to show factories and power plants and other establishments to foreigners is based on the frequently unconscious but nevertheless healthy intention to instill confidence in the efficiency of the American industry.

Oakite Service Men Study Cleaning Problems

The ninth annual sales conference of the Oakley Chemical Co. was held at the New York office, 22 Thames St., Dec. 7, 8, 9 and 10. This was one of the most efficient conferences ever held by the company, every meeting beginning at the scheduled time and everyone taking some part in the proceedings.

There were eight sessions, most of them devoted to practical talks by the sales-service men on the many applications of Oakite. The papers covered dairy work, textiles, railways, automobile cleaning and painting, laundry work, power plants and machine shops, both as to cleaning and to cutting with various tools, from grinding to turning and milling.

As usual, the president, D. C. Ball, gave a welcome to the men in his genial manner, and showed his appreciation of their work in various ways. This was seconded by vice-president Smith, and every man was made to feel that he was working with, rather than for, the home office. Among the papers of special interest to machine shops, both railroads and elsewhere, were these: "Standardizing a Railroad on Oakite Material," by R. E. Powell; "Oakite Compounds for Cutting, Grinding etc.," by J. A. Maguire; and "Oakite Materials in Automobile Factories," by H. C. Duggan. In the former Mr. Powell pointed out over 90 separate items of cleaning in railway work.

One session was devoted to group conferences on ten subjects, such as railroads, power plants, textiles, paper mills and metal industries, so that all the men could receive special suggestions as to their particular work. All the sessions brought out the great attention paid to giving service in cleaning and cutting problems to customers in all lines. That this is fully appreciated in some cases at least, was evidenced by a letter from a high official of a large company to Mr. Ball, commending the work of one of his men in assisting him to solve some new and very difficult problems in cleaning. Such appreciation shows a high order of talent in a sales-service force.

Among the social features were the usual dinner and theater party for both the men and their wives and guests, and the business banquet. Both dinners were at the Hotel Pennsylvania.

"Silver Anniversary" Auto Show in Detroit

Detroit's "Silver Anniversary" automobile show will be held in Convention Hall, Jan. 23 to 30, it has been announced by the Detroit Auto Dealers' Association. Space reservations have been made for 34 makes of passenger cars and 12 makes of commercial vehicles. There will be 200,000 sq.ft. of floor space, making it the largest in this respect, of any show in this country.

In view of the fact that this is the twenty-fifth annual Detroit show, the association is planning an elaborate decorative setting in keeping with the anniversary, and it is the aim of the management to make this year's exhibition superior to any that has ever been held in America.

Already, several events have been announced for Detroit Show Week, including the annual convention of the Society of Automotive Engineers as well as the annual convention of the Michigan Automotive Trade Association.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

(Copyrighted, Theodore H. Price Publishing Corporation, 16 Exchange Place, New York)

BUSINESS in the United States has now reached a condition in which its general tendency rather than its details must be studied by those who would arrive at reasonable conclusions with regard to its always uncertain future.

But because the impulses by which business is directed originate elsewhere and are tardily reflected in New York the general tendency is not so easily or so promptly discernible here as in what New Yorkers mistakenly call the hinterland, where nine-tenths of our consumers and a larger proportion of our producers live.

For these reasons I expect to spend the next few weeks traveling and will telegraph a summary of what I see and hear for inclusion in these letters by my editorial associates who will add a brief summary of the more important financial and commercial happenings of the week.

I am going first to Florida as the boom there has now reached a stage that makes it a psychological influence of prime importance.

From Florida I will go to Cuba to investigate the conditions under which sugar is grown and marketed.

Beyond this my itinerary is not decided upon, but I shall probably return via New Orleans and the Middle-West where I hope to learn of basic conditions at first hand.

From the New York viewpoint the changes which took place last week were not important or significant. Wall Street has had the best year in its history, and the bankers and brokers seem willing that business should slow down as the holidays approach.

But that is not to say that the security markets will decline, for confidence in the future is undiminished and most corporations, including the railroads, are reporting record earnings.

The life insurance companies in particular have done an unprecedented business as a result of which they have enormous sums to invest. Directly or indirectly the capital they supply has helped to finance many of the new buildings that are being put up.

Wholesale trade is always dull during December but the retailers report the largest Christmas business on record.

Most raw commodities are firm and in good demand but there are some exceptions.

Rubber, coffee, copper, zinc, lead, and wool have all shown an easy tendency that is perhaps to be explained by the fact that each of the articles named is supposed to be under syndicate control, and that speculators are in consequence afraid to buy them.

The cotton market declined about half a cent a pound upon publication of the Government's final crop estimate for the season, which indicated a yield of 15,603,000 bales, but prices immediately recovered. Later in the week, the market turned slightly easier. At or about present levels there appears to be a demand for all the good cotton that is for sale.

The wheat market has had a period of relative steadiness during the past week. But whether this marks the culmination of the recent sharp rise, or whether it is merely a breathing spell prior to further advances, it is still too early to tell. The latest crop reports from the Argentine and Australia, however, are less pessimistic, and estimates on the Canadian crop have been raised to 450,000,000 bushels.

But, as above remarked, a discussion of details is unnecessary.

Two important addresses were delivered by President Coolidge last week; one on Monday before the American Farm Bureau Federation at Chicago, and his annual message to Congress on Tuesday. The former is generally regarded as the more significant of the two, because it seems to indicate a fear in administration circles that the farm problem is not yet a thing of the past, despite the much-heralded return of agricultural prosperity.

There is no doubt that America is upon the whole highly prosperous. The only fear is that the position may get out of balance; that we may produce more than we can consume or sell, or that we may not be able to finance our expansion. But as to the latter, the weekly statement of the Federal Reserve Banks is reassuring and a possible money stringency is still *in futuro*, although it may be somewhat nearer.

It is certain that the economic machine will get out of gear and be halted sooner or later, but for the present it seems to be running smoothly, and the money spent during the holidays will keep it going for a good while yet, unless something unexpected happens to change the psychological condition of the American business mind.

In Europe as here a feeling of optimism is spreading. The French people have eagerly taken the anodyne of inflation administered by Briand and Loucheur. The franc is in consequence lower but no one seems especially concerned, and it is taken for granted that the bankers who sold the French dollar bonds held in this country have assurance that they will be met.

Great Britain is much more cheerful, and the only minor note of Europe's Christmas symphony is to be heard in Russia where armies of vagrant children are reported to be begging for food and shelter.

What's Doing in Industry

With the first half of December just completed, machine tool and machinery business has reached proportions that were considered impossible for this time of the year. Holidays and the taking of inventories have caused some slight let up in new orders, but the slack has not been as severe as some had predicted. Inquiries are more plentiful than in some weeks, leaving the impression that orders will follow as soon as the new year gets under way.

Mid-Western industrial cities are compiling sales figures that are expected to exceed the totals of several years back. Detroit continues at the head of the list, with automobile manufacturers providing endless prospects for new orders. In Cincinnati business is increasing, orders running in larger amounts than heretofore. Chicago sales are well maintained, with the added encouragement of a busier season in the used machinery market. The number of new inquiries received in the Indianapolis section brings promise of activity early in the new year.

Buffalo reports business exceptionally good for this time of the year, plenty of small orders helping to swell the total. Canadian business is improving, with the expansion of industrial enterprises furnishing the motive. The New York market remains stolid, orders for single tools being the outstanding feature.

There is no doubt that America on the whole is highly prosperous. It is also certain that our economic machine will get out of gear sooner or later, but for the present it seems to be running smoothly.

The Industrial Review

Progress of the machinery and machine-tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

Cincinnati

A very gratifying feature of the machine tool market in the past week, as pointed out by Cincinnati manufacturers and selling agents, is that the size of orders received has increased, as well as the number. This is taken to indicate that the period of hand-to-mouth buying is now drawing to a close, and a period of purchasing for expansion is about to begin.

Two railroads have placed fair-sized orders in the past few days, and others are expected to do likewise in the near future. The automotive industries continue to be the largest buyers and an increased number of inquiries are coming from this source, indicating buying for expansion as well as for replacement.

The numerous orders for single tools coming from small machinists and industrial users of machine tools form a large aggregate. The past week's purchases have been well diversified, with orders well distributed over the various sections of the country. More export orders are reported to have been booked than in the previous week, and it is regarded that prospects for an increased amount of foreign business are getting better.

Selling agents report that there has not been the customary end-of-the-year dropping off of orders, but that the reverse has been the case, and the market is getting better as the year draws to a close. It is freely predicted that purchases for expansion will soon become the feature of the market.

Canada

Very little change in the machine tool and machinery markets in Canada has taken place during the last two weeks. Having in mind the year-end inventory activities, manufacturers are not disposed to buy heavily at the moment. Purchases for immediate use, however, are good.

Business throughout the metal-working field in November is reported to have been much better than in the corresponding month last year. Warehouse business in central Canada is good, with the exception of certain seasonal products, such as structural material, demand for which is tapering off. Steel mills have already booked a considerable amount of first quarter business.

Business generally throughout the country is steadily improving, with an optimistic feeling prevalent in practically all sections regarding prospects for the immediate future.

Indianapolis

The last fortnight has seen some spottiness develop here both in tool and machinery demand. Most leaders in the trade here expect but a desultory sort of business from now until after the first of the year. They say this situation generally prevails here at this time of the year and the fact that inquiries are numerous leads to the belief that business will show a marked upward trend after January first.

Most of the dissatisfaction is expressed by dealers in special machinery for use in lumber and furniture factories. They say that sales and inquiries have fallen off and many factories are curtailing production. However, before the influx of orders at the mid-winter furniture shows, a number of additions and replacements are prospective.

Railroad tool and machinery demand is uncertain, some roads working their shops in Indiana overtime, and others laying off men. A good machinery demand continues to come from the coal fields in western Indiana. This demand is expected to increase due to the fact that since the resumption in work this fall, many mines are now just getting on the right side of the ledger.

A good business is being done by manufacturers of glass making machinery. Dealers in used machinery report the market rather quiet.

New York

Due to the time-honored belief that business in machinery and allied products should be quiet just before the first of a new year, reports indicate a state of lassitude in this market. Few large orders have been placed, but there has been a noticeable increase in new inquiries that promise a rush of business immediately after the holidays.

Small tools are active, and large machines of special design and construction for single purpose duty are in fair demand. Standard types are rather slow.

The bulk of present business is represented in single pieces, placed as necessity demands replacement of obsolete or worn-out equipment.

The second-hand market is experiencing a shortage of certain types of machines, and it is generally conceded that few good tools are available at this time.

Orders placed in the past week called for lathes, milling machines, surface grinders and shears. Several orders for cranes were also registered.

Buffalo

Considering the fact that December is invariably a dull month—often, the dullest month of the year—the condition of the machine-tool trade in Buffalo is exceptionally good.

Dealers quite generally agree that as Decembers go this will be a good one, although it will probably fall short of the business for November.

There are few, if any, of what may be termed big orders placed, or in sight, but a large number of small ones have been pretty well distributed over the trade.

Inquiries relative to January business are unusually numerous and most dealers feel that the first three months of the new year will be exceptionally good. On the basis of present conditions some go so far as to predict a fine business for the first six months of the year.

It has developed in recent weeks that several contractors are going to work through the winter, therefore the business in contractor's equipment, which has been the one weak spot in the local trade recently, has improved and there is reason to believe the improvement will be greater later on. There is some good crane business in sight.

One cheering fact is that all of the pattern shops are busy at present. And there is another indication of good future business in the fact that the business uncertainty and pessimism which existed here a year ago, in the face of a lot of national boosting, has been entirely eliminated and replaced by a solid optimism and a feeling of assurance for future good business.

Chicago

Business in the machine tool industry, taking into account the near approach of the holiday season and the beginning of stock taking by many industrial concerns, is being surprisingly well maintained. Especially is this true with respect to used machinery. Large dealers in this line report inquiries and sales in excess of expectations. Orders taken for shipment to points as far east as Philadelphia are not infrequent, but the distribution is chiefly confined to nearby states. Shapers, millers and punch presses are the tools most in demand, toolroom lathes coming next.

One of Chicago's largest handlers of used machinery expressed to the writer his belief that, owing to delayed deliveries in certain lines of tools by manufacturers, and the uncertainty of the future as regards filling orders, the market for used tools would continue active for many weeks to come. No sales of unusual importance to large industrial plants are reported.

Detroit

Firms handling machinery and machine tools in the Detroit district, after a year of steady sales, are now looking into 1926 and preparing for the business which the new year is expected to bring forth.

Nineteen twenty-five has seen the establishment of another record in the manufacture of automobiles, but already automotive experts are predicting a production of close to five million cars for 1926.

A survey of the local machine tool dealers shows an optimistic feeling permeating the field as a whole. While the present year began slowly, with sales during the first three months only fair, the succeeding nine months have been among the most prosperous ever enjoyed in the world's automobile capital.

Additions to plants and extensive purchases of new equipment will put six companies into the thousand-a-day class early in January. Among Ford, Dodge, Chevrolet, Hudson-Essex, Buick and Willys-Overland some 16,000 cars will be turned out every twenty-four hours.

As the first step in a two-million dollar expansion program the Buick Motor Co. has started construction of an addition to its engine plant to make possible a daily production of 1,200 engines. The plant will cover twelve acres of ground. It will be one story in height, 990 ft. long and 360 ft. wide. Several small operations will be moved into the addition, which will be 90 ft. wide and 300 ft. long. This will make room for additional machinery for operations on larger pieces, such as cylinder blocks, crankcases, crankshafts, etc. The new machinery has been purchased and will be installed as soon as the building is ready.

The increase in valve-in-head engine production to 1,200 per day will be followed by other additions of machinery and equipment to bring other units of the factory to the same capacity.

The trend toward heavier automobile output in 1926 has been felt in the steel centers. The Steel Products Co., of Cleveland, has just received an order for $2,500,000 worth of automobile parts. According to Charles E. Thompson, president of the company, this is the largest single order ever written on the company's books.

Machine Tool Manufacturers at the Lyons Fair

A wide range of standard machine tools will be on exhibition and for sale at the Lyons Fair to be held March 1 to 14, 1926. Among the names of the exhibitors listed below will be found many American firms.

Bolt-making machinery:
- A. Blachon, 186 avenue de Saxe, Lyon
- M. Raigorodski, 54 rue de Clichy, Paris

Casting machines:
- Etablissements A. Utard, Longeville-en-Barrois (Meuse)

Compressors and pumps:
- Bavox (Etablissements Samga & Bavox Réunis), 23 boulevard Gouvion-Saint-Cyr, Paris (17e)

Drilling and boring machines:
- W. F. & John Barnes Co., Rockford, Ill., U.S.A.
- Burton Fils, 68 rue des Marais, Paris
- Fosdick Machine Tool Co., Cincinnati, Ohio, U.S.A.
- Gambin & Cie., 128 rue du Point-du-jour, Billancourt (Seine)
- L. Idoux, 64 grande rue de Monplaisir, Lyon
- Taylor & Fenn, Hartford, Conn., U.S.A.

Forging machinery:
- National Machinery Co., Tiffin, Ohio, U.S.A.

Gear-cutting machinery:
- Gleason Works, Rochester, N. Y., U.S.A.

Grinding machines:
- C. Béroujou, Saint-Étienne-les Ouillières (Rhone)
- Diamond Machine Co., Providence, R. I., U.S.A.
- Etablissements, L. D. Clesse, 119 rue Antoine-Dansaert, Brussels, Belgium
- Mardon (Pétrus), 55 rue Magenta, Lyon-Villeurbanne

Grinding machines, internal:
- Arter Grinding Machine Co., Worcester, Mass., U.S.A.
- Rivett Lathe Co., Brighton Dist., Boston, Mass., U.S.A.

Grinding wheels:
- Durrschmidt (Etablissements G.), 5 rue des Dahlias, Lyon-Monplaisir
- Fabrique Suisse de Meules Abrasives, Winterthür, Switzerland
- Vinay & Janin, 47 avenue Bertholet, Lyon

Industrial lubrication:
- Société Anonyme Myrelit, 16 rue d'Orléans, Neuilly-sur-Seine (Seine)
- Técalémit (Etablissements), 18 rue Brunel, Paris

Lathes (automatic):
- Hugenschmidt, 5 rue Boulle, Paris (2e)

Lathes (automatic capstan):
- Cuttat & Cie., 53 rue Servan, Paris (11e)

Lathes:
- Porter-Cable Machine Co., Syracuse, N. Y., U.S.A.
- Reed-Prentice Co., Worcester, Mass., U.S.A.

Machinery:
- Etablissements Moerch & Roumet, 49 rue Archereau, Paris
- Vial, 10 rue Voltaire, Vichy (Allier)

Machinery (automatic production):
- Baird Machine Co., Bridgeport, Conn., U.S.A.

Machine Tools (general):
- Agence Européenne de Machines-Outils (Maurice-Laur), 30 boulevard Bineau, Levallois-Perret (Seine)
- Agenzie rappresentanze machine industriali, 63 Corzo Venezie, Milan, Italy.
- Anciens Etablissements Martinet-Thibaud, 15 place Bellecour, Lyon
- Ateliers de Construction mécaniques Georges Hody, Vrigne-aux-Bois (Ardennes)
- Aux Forges de Vulcain, 1-5 place de l'Abondance, Lyon
- A. Blachon, 186 avenue de Saxe, Lyon
- Brown & Sharpe Manufacturing Co., Providence, R. I., U.S.A.
- Laurent Burdin (Anciens Etablissements Charton & Cie.), 2 quai Gailleton, Lyon
- Cuttat & Cie. (Société des Anciens Etablissements), 53 rue Servan, Paris (11e)
- Descours & Cabaud, 120 grande rue de la Guillotière, Lyon
- Etablissements E. Maisongrande, 22 boulevard Ayrault, Angers
- Fenwick Freres & Cie., 8 rue de Rocroy, Paris, 112 rue des Belges, Lyon
- Jost & Cie., 105 rue Villiers-de-l'Isle-d'Adam, Paris (20e)
- Laurent Kertzmann, Cité Popincourt, Paris
- Albert Rousset, 146 avenue de Saxe, Lyon
- Société d'Outillage Mécanique et d'Usinage d'Artillerie (S. O. M. U.A.), 146 boulevard Victor Hugo, Saint-Ouen (Seine)
- A. Voumard (Veuve)
- Raymond David, 1 rue de la Vierge, Lyon
- Schutz & Cie., 112 cours Vitton, Lyon

Milling Machines:
- Gambin & Cie., 128 rue du Point-du-jour, Billancourt (Seine)

Mortising Machinery:
- Rhodes Manufacturing Co., Hartford, Conn., U.S.A.

Presses:
- J. Perrin & Fils, 201 rue de la Republique, Belleville-sur-Saône

Riveting Machinery:
- Ch. Guillemin, rue Stearinerie, Dijon (Côte-d'Or)
- Waterbury, Farrel Foundry and Machine Co., Waterbury, Conn., U.S.A.

Sawing Machines:
- Burton Fils, 68 rue des Marais, Paris

Screw Machinery:
- Hanson-Whitney, Hartford, Conn., U.S.A.

Shapers and Planers:
- Ateliers G.S.P. (Réunion des Usines Guillemin, Sergot et Pegard-Gerony & Leturcq), 55 boulevard de la Villette, Paris (10e)

Shears (circular):
- Pinchard, Deny Frères, 58 rue Saint-Sabin, Paris (11e)

Stamping Machinery:
- Billings & Spencer, Hartford, Conn., U.S.A.
- Erie Foundry Co., Erie, Pa., U.S.A.
- Etablissements Rouaud, 45 rue des Petites-Ecuries, Paris (10e)
- Ferracute Machine Co., Bridgeton, N. J., U.S.A.

Transmission Equipment:
- Boucher, Clement, Alkan & Simony, 135 rue Amelot, Paris (2e)
- Gustave Fouillaron, 9 rue Deveau, Cholet (Maine-et-Loire)
- Société des Engins Graisseurs, 204 rue Michael-Bizot, Paris.

News of the Automotive Industry

Exports of automobiles from Canada and the United States during October were valued at $31,156,269, almost a million dollars in excess of the figure for September. The United States total was $26,577,740.

Imports of foreign passenger automobiles into France in the first 9 months of 1925 comprised 13,713 units, as compared with 9,913 in the corresponding period of 1924. Their value was 112,637,000 francs, as compared with 79,188,000 francs. Of these imports, 12,669 units came from the United States, 785 from Italy, 84 from Belgium, and 60 from Great Britain.

The Moon Motor Car Co. has established a warehouse at Douglas, Ga., with capacity for storing 500 cars, to meet the heavy demand for Moon and Diana cars in Florida and the freight embargo situation in that state. Moon last week shipped a trainload of 39 freight cars to Douglas from which point the cars will be driven over land into Florida.

The largest shipment of merchandise ever made from Indianapolis left the Marmon factory November 28. It consisted of a solid trainload of 50 freight cars containing Marmon cars, consigned to Jacksonville, Fla., for driveaway by 15 distributors to various points in Florida. The total trainload was valued at over $500,000.

The export business of the Packard Motor Car Co. has increased to such an extent that the company has found it necessary to build a new boxing and shipping department for foreign business. The new department is equipped with the latest labor saving devices.

Sales of Hupp eight-cylinder cars, introduced the first of this year, to date total $32,000,000. Hupp's production last month was 4,361 eights and sixes. This was 57 per cent greater than preceding month and 311 per cent above November, 1924, production.

Growth in foreign demand for Reo bus chassis is shown by recent orders received. An order for 12 chassis, which will be fitted with pay-enter bodies by the Fitz John Manufacturing Co. of Muskegon, was received from Porto Rico. This is in addition to an order for 50 such buses just delivered. Reo recently made a shipment of 48 buses to Bristol, England.

The Paige-Detroit Motor Car Co. has introduced a new line of Jewett six-cylinder cars with a number of distinctive features. Other models in this line will be brought out later. Cars will have steel bodies and four-wheel hydraulic brakes.

The Cadillac Motor Car Co. has turned out its 200,000th car equipped with a V-type, 90-degree eight-cylinder engine. This output was attained in 11 years.

William C. Durant, head of Durant Motors, has acquired a 25 per cent interest in the capital stock of the Stewart-Warner Speedometer Corporation, according to statements made last week in financial circles. At the offices of Mr. Durant it was said that no official statement would be issued at this time.

Tests have been made at Packard Field of the first airplane manufactured by the Buhle-Vervile Aircraft Co. of Detroit. The plane is a commercial type adaptable to passenger carrying, aerial photography, insecticide dusting, student pilot training and light cargo work. It carries a gasoline tank with capacity of 40 gallons, sufficient for five hours' flight. Features of the plane include folding wings, interchangeability of many of the bearing and guiding surfaces, adjustable stabilizer and wide-tracked axleless landing gear.

What the Railroads Are Doing

New rolling stock and track material calling for the expenditure of $15,000,000 has been purchased by the New York Central Lines, officials announced last week. Ten electric engines for use in New York territory are included in the rolling stock equipment. Two Diesel electric engines, one passenger and one freight, were also purchased, constituting the first oil electric road engines bought by any road in the country.

Other rolling stock included 1,550 freight-cars of which 500 were automobile boxcars of fifty-five ton capacity, and 1,050 hopper cars of fifty-five ton capacity and 274 passenger train cars. In the passenger train equipment ordered were 150 all-steel coaches, forty-three steel baggage cars, twenty dining cars, twenty milk cars and nine combination passenger and baggage cars. The equipment alone without the track material cost approximately $11,500,000, the latter including tie plates, angle bars, spikes and bolts.

The locomotive orders were placed with the American Locomotive Co. and the McIntosh & Seymour Corporation. The freight and passenger car orders were divided among the American Car and Foundry Co., the Pressed Steel Car Co., the Pullman Car and Manufacturing Co., Standard Steel Car Co., the Osgood-Bradley Car Co., the Merchants' Despatch Transportation Co. and the New York Central Railroad Co.'s shops.

Other orders announced include one for 500 mine cars from the Rochester & Pittsburgh Coal Co. with the American Car and Foundry Co. and the Bethlehem Steel Co., forty-three coaches for the Norfolk & Western and fifty-six additional coaches for the Erie placed with the Standard Steel Car Co.

The Atchison, Topeka & Santa Fe Railway Co. has applied to the Interstate Commerce Commission for authority to acquire control of the Healdton & Santa Fe Ry. by the purchase of its capital stock.

Personals

COLONEL C. H. TENNEY, chief of the Boston ordnance district, is in Washington takink a course at the Army War College.

O. C. WILLEY, foreman of the tool room of the Cincinnati Planer Co., has been made superintendent of the plant.

M. B. CRIDER has resigned as purchasing agent for the Niles Tool Works, Hamilton, Ohio.

W. J. HENRY has been appointed manager of the Charlotte, N. C., office of the Harnischfeger Corporation, of Milwaukee.

C. E. PHILLIPS has been placed in charge of the Wilkes-Barre office of the Allis-Chalmers Manufacturing Co.

CLARENCE E. HONHORST has resigned as superintendent of the Cincinnati Planer Co. and has assumed a similar position with the William Powell Co., of Cincinnati.

J. W. BOLTON has resigned as metallurgist with the Niles Tool Works, Hamilton, Ohio, and is now with the Frank Foundries Corporation, at Moline, Ill.

B. C. SAWYER, purchasing agent for Bethlehem Fabricators, Inc., of Bethlehem, Pa., has been elected president of the Purchasing Agents' Association of the Lehigh Valley.

L. A. SCHMIDT has been appointed consulting engineer for the Locomobile Co. of America, at Bridgeport, Conn. He was formerly associated with the Fiat organization.

MAHLON M. MCCALL, formerly mechanical engineer with the Worthington Pump and Machinery Co., of Cincinnati, has joined the Niles Tool Works, at Hamilton, Ohio, as assistant chief draftsman.

HENRY C. HOUCK, assistant general merchandise manager of the General Electric Co., has been appointed manager of the merchandise department at the Bridgeport works of the company.

H. J. WARNER, of Detroit, formerly with Continental Motors and the Federal Truck Co., has been appointed head of manufacturing purchasing for the **General** Motors Truck Co. He succeeds A. J. Banta, resigned.

R. B. SINNOCK, formerly of the Dayton-Dowd Co., of Quincy, Ill., has joined the sales force of the Climax Engineering Co. and will be located at the company's office in Clinton, Iowa. C. H. Adams has also become associated with this company and will travel in the Southeastern district.

E. J. WAGNER, formerly general manager of the Standard Gauge Steel Co., of Beaver Falls, Pa., is now head of the Standard Steel Specialty Co. which has purchased the business in machine and Woodruff keys, taper pins and machine racks from the Union Drawn Steel Co.

Business Items

The International Motor Co., manufacturer of the Mack truck, has purchased the plant of the Niles-Bement-Pond Co. at Plainfield, N. J.

The Chicago Pneumatic Tool Co., of New York, has made arrangements with Motoren-Werke, Manheim, Germany, whereby it has acquired exclusive rights to the manufacture and sale of Benz solid injection Diesel engines in the United States and Canada.

The Chemical Treatment Co., Inc., of New York, manufacturer of chrome-alloy metal known as "Crodon," has purchased a plant in Waterbury, Conn., formerly used as a brass tube mill by a well-known manufacturer. This will be known as Plant No. 2 of the Crodon units.

The Walla Walla Iron Works, at Walla Walla, Wash., has purchased the entire plant of the Self Oiling Wheel and Bearing Co. The new plant, after certain modifications in layout, will be used as a machinery assembly unit.

The Murray Body Corporation, of Detroit, is in the hands of a receiver following the appointment of the Guardian Trust Co. by the Federal Court. The receiver has already taken possession of the company's plant. The business will be continued as it is now established, it is stated, pending receivership.

The Kent Machine Co., of Kent, Ohio, announces the recent purchase of the Falls Clutch and Machinery Co., of Cuyahoga Falls, Ohio. The business office of the Falls company will be removed to Kent, but the present intention is to manufacture the old established line of transmission machinery at both plants.

Announcement has been made that United States Senator James Couzens will enter the manufacturing field with an ice manufacturing machine. The new firm, according to the announcement, will have a capitalization of $1,000,000. In the new venture Couzens will have as his aide, Joseph A. Martin, former acting mayor, and for three years commissioner of public works under the Couzen's administration in Detroit.

The American Foundry Equipment Co. Inc., of New York, has purchased from the Dodge Manufacturing Corporation, Plant No. 4 at Mishawaka, Ind., for the purpose of combining the Chicago and York, Pa., factories, and executive offices from New York City. The move into the new plant will start about Jan. 1. With the consolidation of all activities in one plant, the following reorganization of the company has been effected: E. A. Rich, Jr., vice-president in charge of sales; Fred Graf, formerly foundry engineer for Frank B. Chase, has been elected vice-president in charge of production, development and engineering; O. A. Pfaff continues as treasurer; G. E. Wyatt appointed assistant sales manager and advertising manager; Harry A. Schwartz, inventor and patentee of the Schwartz di-mold process for making castings will be actively associated with the company. Charles D. Steinmeier, who has been in charge of the plant at York, Pa., will be in charge of commercial development of the Schwartz process. James Rigby, formerly sales manager, continues with the company as Eastern district sales manager.

Obituaries

WILLIAM H. BEARDSLEY, chairman of the board and former president of the Florida East Coast R.R., died at his home in New York on Dec. 13.

ROWAN P. PERKINS, mechanical engineer associated with the B. F. Sturdevant Co., of Boston, died in New York on Dec. 10. His home was in Philadelphia.

EDWARD G. DUNBAR, formerly president of the Dunbar Bros. Co., now part of the Wallace Barnes Co., died at his home in Bristol, Conn., on Dec. 7. He was 38 years old.

Catalogs Wanted

Pio Serra, of Calle 25 De Agosto 514, Montevideo, Uruguay, would like to receive catalogs from American manufacturers covering lathes, planers, shapers, drilling machines (both radial and upright), milling machines and slotters.

Calendar of Local Meetings

National Association of Cost Accountants

Buffalo Chapter. Dec. 17. "Handling Production Costs from Raw Material to Finished Product."

Boston Chapter. Dec. 17. "Administrative and Selling Costs," by Charles F. Rittenhouse.

Scranton Chapter. Dec. 22. "Inventory Control," by LeRoy Chappell.

San Francisco Chapter. Dec. 28. "Preparing to Start the New Year Right—What Should Be Done?"

Society of Automotive Engineers

Detroit. Dec. 17. Methods of Cylinder Lapping.

Chicago. Dec. 18. "Present Day High Efficiency Motors," by Fred S. Duesenberg.

Northern California. Dec. 29. "Problems of Fleet Operation," by Harold Jarvis.

New York. Jan. 14. Annual dinner, Hotel Astor.

Detroit. Jan. 26 to 29. Annual meeting.

American Society for Steel Treating

Buffalo. Jan. 21 and 22. Winter sectional meeting, Hotel Statler.

Hartford. June. Spring sectional meeting.

Forthcoming Meetings

American Association for the Advancement of Science. Annual meeting, Kansas City, Mo., Dec. 28, 1925, to Jan. 2, 1926. Burton E. Livingston, secretary, Smithsonian Institute Bldg., Washington, D. C.

American Society for Steel Treating. Winter sectional meeting, Hotel Statler, Buffalo, N. Y., Jan. 21 and 22. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

Society of Automotive Engineers. Annual meeting, General Motors Bldg., Detroit, Jan. 26 to 29. Coker F. Clarkson, secretary and general manager, 29 West 39th St., New York City.

The Weekly Price Guide

Rise and Fall of the Market

Iron and Steel—Iron market is firm. Foundry coke up $1 per ton at Connellsville, compared with week ago. Scrap moving slowly at present. Orders on books of U. S. Steel Corp., Nov. 30, were heavier than for corresponding date in any year since 1922. The trend in steel demand has been consistently upward since Sept. 1. Plates are particularly firm just now, with quotations ranging from $1.70 to $2 per 100 lb., Pittsburgh. Bars are $2@$2.10, with slightly less demand than a week ago. Shapes have hovered at $1.90@$2, per 100 lb., Pittsburgh, since May, 1925; less than carload lots at $2.10.

Non-Ferrous Materials—Compared with the Dec. 4 level, copper is up ¼c. and antimony, ½c. per lb., while tin dropped ⅞c. and lead, ¼c.; zinc is unchanged. Fabricated brass and copper and scrap are lower than a week ago. Linseed oil dropped 0.4c. per lb. at Cleveland.

(*All prices as of Dec.* 11)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.05
Northern Basic	24.27
Southern Ohio No. 2	24.27
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	28.37
BIRMINGHAM	
No. 2 Foundry	22.00@23.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	24.16
Virginia No. 2	29.17
Basic	23.16
CHICAGO	
No. 2 Foundry local	23.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	26.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	22.27
Basic	22.27
Bessemer	22.27

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb:

Detroit	5.00@5.50
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	New York	Cleveland	Chicago
No. 10	2.40@2.50	3.89	3.15	3.50
No. 12	2.45@2.55	3.94	3.20	3.55
No. 14	2.50@2.60	3.99	3.25	3.60
No. 16	2.60@2.70	4.09	3.35	3.70
Black				
Nos. 18 to 20	3.05@3.15	4.15	3.75	3.90
Nos. 22 to 24	3.10@3.20	4.20	3.80	3.95
Nos. 26 and 27	3.15@3.25	4.25	3.85	4.00
No. 28	3.25@3.35	4.35	3.95	4.10
Galvanized				
No. 10	3.50@3.60	4.35	4.25	4.25
Nos. 12 to 14	3.60@3.70	4.45	4.35	4.35
No. 16	3.75@3.85	4.60	4.50	4.50
Nos. 18 to 20	3.90@4.00	4.75	4.65	4.65
Nos. 22 to 24	4.05@4.15	4.90	4.70	4.80
Nos. 26 and 27	4.20@4.30	5.05	4.95	4.95
No. 28	4.50@4.60	5.35	5.10	5.25

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameters Inches External	Diameters Inches Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness B.W.G. and Decimal Fractions	Outside Diameter in Inches ⅛	¼	⅜	½	⅝	1	1⅛	1¼
	Price per Foot							
.035″	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049″	18	.17	.18	.19	.20	.21	.23	.25
.065″	16	.19	.20	.21	.22	.23	.25	.27
.083″	14	.20	.22	.23	.24	.25	.27	.29
.095″	13	.21	.23	.25	.26	.27	.29	.31
.109′	12	.22	.24	.26	.27	.28	.30	.32
.120″ or .125″	11	.23	.25	.27	.28	.29	.31	.33
.134″	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.85	4.15
Cold rolled strip steel	6.35	6.35	6.80
Floor plates	5.55	5.60	5.50
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.20	3.10
Soft steel bars (base)	3.24	3.10	3.00
Soft steel bar shapes (base)	3.24	3.11	3.10
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.40	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	50@60%	55%	60%

Electric welding wire, New York, 3/32, 8.25c.; ⅛, 7.85c.; 5/32 to ¼, 7.35c. per lb. *Flat, 3/16@¼-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			14.62½
Tin, 5-ton lots, New York			63.75
Lead (up to carlots) E. St. Louis	9.15	New York	10.00
Zinc (up to carlots) E. St. Louis	8.75	New York	9.75

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot	22.00	21.25	20.00
Copper sheets, base	22.75	22.75	22.75
Copper wire, base	19.87½	16.75	16.50@16.75
Copper bars, base	22.37½	21.25	22.37½
Copper tubing, base	24.75	24.75	24.75
Brass sheets, base	19.37½	19.12½	19.37½
Brass tubing, base	24.00	23.75	27.37½
Brass rods, base	17.12½	16.87½	17.12½
Brass wire, base	19.87½	19.62½	19.87½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	28@29	28.00	28.03
Zinc sheets (casks)	12.00	12.60@12.95	12.27
Solder (½ and ½), (case lots)	40.25	41.00	38@42
Babbitt metal, delivered, New York, cents per lb.:			
Genuine, highest grade			80.75
Commercial genuine, intermediate grade			56.00
Anti-friction metal, general service			31.50
No. 4 babbitt (f.o.b.)			14.50
Nickel, f.o.b. refinery, cents per lb.:			
Ingots 31.00 Electrolytic 38.00		Shot	32.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00
Manganese nickel hot rolled rods "E"—low manganese (base)	54.00
Manganese nickel hot rolled rods "D"—high manganese (base)	57.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	40.00
Blocks	32.00	Cold drawn rods (base)	48.00
Ingots	38.00	Hot rolled sheets (base)	42.00
Cold rolled sheets (base)			50.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	11.75@12.00	11.25	11.25@11.75
Copper, heavy, and wire	11.50@11.75	11.50	11.00@11.50
Copper, light, and bottoms	9.75@10.25	9.50	9.75@10.25
Heavy lead	8.00@8.50	7.50	8.00@8.50
Tea lead	6.00@6.50	5.00	7.00@7.50
Brass, heavy, yellow	7.25@7.50	7.25	7.25@7.75
Brass, heavy, red	9.50@10.00	9.50	8.50@9.00
Brass, light	6.00@6.50	6.00	7.25@7.75
No. 1 yellow rod turnings	8.25@8.75	8.00	7.50@7.75
Zinc	5.25@5.50	4.75	5.00@5.50

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$11.25	$11.45	$11.50
"A" Grade:				
IC,	14x20	8.85	9.40	9.50
	Coke Plates—Primes.			
100-lb.,	14x20	6.45	6.10	7.00
	Terne Plates—Small lots, 8-lb. Coating			
IC,	14x20	7.30	6.95	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.15@0.22	$0.19	$0.20
Cotton waste, colored, per lb.	.10@.15½	.10	.17
Wiping cloths, washed white, per lb	.17	36.00 per M	.15½
Sal soda, per 100 lb. keg	2.25	2.25	2.75*
Roll sulphur, per 100 lb. keg	3.75	3.75	4.50
Linseed oil, per gal., 5 bbl. lots	.99	1.10	1.02
Lard cutting oil, 25% lard, per gal.	.55	.50	.54
Machine lubricant, medium-bodied (50 gal. wooden bbl.), per gal.	.35	.35	.26
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft. per inch of width for single ply.			
Medium grade	40%	40%	30–10%
Heavy grade	30–10%	35%	30–5%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 175 lb. kegs.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb.	.04	.0415	.0405
Brass rods	per lb.	.1712½	.1737½	.1637½
Solder (½ and ½)	per lb.	.4025	.40	.40@.41
Cotton waste	per lb.	.15@.22	.15@.22	14@21
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	6.50
Emery, disks, cloth, No. 1, 6 in. dia.	per 100	3.55	3.55	3.38
Lard cutting oil	per gal.	.55	.55	.55
Machine oil	per gal.	.35	.35	.29
Belting, leather, medium	off list	40%	40%	40–2½%
Machine bolts up to 1x30 in.	off list	40%	40%	45%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.46	$5.84	$5.65
Emery paper	10.71	11.00	10.71
Emery cloth	29.48	31.12	29.48
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.49	1.41	1.49
Cloth	3.55	2.67	3.20
Fire clay, per 100 lb. bag		.60	.75
Coke, prompt furnace, Connellsville	per net ton		3.50@4.00
Coke, prompt foundry, Connellsville	per net ton		5.00@6.00
White lead, dry or in oil	100 lb. kegs		New York, 15.25
Red lead, dry	100 lb. kegs		New York, 15.25
Red lead, in oil	100 lb. kegs		New York, 16.75

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1¼ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%.

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{5}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x¼-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%.

Nuts, semi-finished, ¼x¼-in., 2c. each. Discount 70% for $\frac{5}{16}$-in and smaller and 65% for ⅜-in. and larger.
Case hardened ¼x¼-in., 6c. each, less 50%.

Rivets, button heads, ⅜-in., ½-in., 1-in. diam. x 2$\frac{1}{16}$-in. to 4½-in. $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{1}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1¼ to 2-in. long, all diameters, 25c.; ⅜-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb., 50c.; countersunk heads, 45c.

Washers, cast iron, ⅜-in., $7.00* per 100 lb. at New York warehouses; ½-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Ia., Dubuque—Brouillet Sheet Metal Wks., 271 Iowa St.,—circle shear for 20 gage iron.

Mass., Orange—P. O. Box 81—Weymouth or Wilder turning lathe.

Mo., St. Louis—J. W. Larmora, 4765 Morganford Rd.—small bench lathe.

O., Columbus—G. J. Teermer & Son, 2583 North High St.—1 joiner, 1 combination rip and cutoff saw.

O., Fremont—Price Lumber & Mfg. Co., W. E. Mead, Genl. Mgr.—woodworking equipment for proposed 50 x 60 ft. plant addition.

O., Tiffin—R. Peebles—square shear, 30 or 36 in., also throatless shear.

O., Wooster—Coxon Beleck China & Illuminating Co., G. Stone, Purch. Agt.—lathes and machinery for metal division of lamp making.

Wis., Cedarburg—City—traveling crane for power house.

Wis., Milwaukee—City, J. Schwada, Engr. 10 ton electric crane.

Wis., Milwaukee—Master Lock Co., 78 West Water St., P. E. Yolles, Pres.—additional machine tools for proposed 1 story factory on Lake Blvd.

Wis., Sheboygan—E. C. Vasselos, 816 Niagara Ave.—repair machinery and small tools for machine and auto repair shop.

N. B., Buctonche—F. D. Irving & Co.—complete saw mill equipment and machinery.

Ont., Collingwood—Canadian Postal Lock Nut Co.—complete equipment for the manufacture of automobile batteries. Estimated cost $30,000.

Ont., Fergue—Superior Barn Equipment Co., G. A. Maude, Engr.—machinery and equipment for the manufacture of tourists' tents, clothes reels, kitchen stools and other specialties to increase capacity of plant. Estimated cost $50,000.

Que., Montreal—The A. R. Williams Machinery Co. Ltd., 326 St. James St., H. S. Hopewell, Mgr.—woodworking machinery (used).

Opportunities for Future Business

Ala., Anniston—M. & H. Valve Co., J. W. Conway, Atlanta, Ga., Pres., awarded contract for the construction of first unit of plant here. Estimated cost $75,000. Noted July 9.

Calif., Oakland—F. A. B. Mfg. Co., 1850 7th St., has purchased site and plans the construction of a factory for the manufacture of barrel pumps for oil and gas, extension frames for Ford trucks and water pumps and truck brakes for Fords at 67th and Vallejo Sts.

Colo., Denver—Colorado Fuel & Iron Co., E. H. Weitzel, V. Pres., plans the construction of a steel plant. Estimated cost $1,500,000.

Conn., New Britain — Landers Frary Clark, Commercial and Center Sts., manufacturers of vacuum cleaners, awarded contract for the construction of a 4 story, 50 x 129 ft. factory.

Ill., Quincy—Gardner Governor Co., South Front St., is having preliminary plans prepared for the construction of a 1 story, 100 x 250 ft. governor factory. Estimated cost $60,000. F. D. Chase, 720 North Michigan Ave., Chicago, Ill. Archt.

Mass., Charlestown (Boston P. O.)—Schoolhouse Department, Boston, awarded contract for the construction of a 2 story addition to high school, including manual training shops at Bunker Hill district here. Estimated cost $150,000.

Mass., Cambridge (Boston P. O.) — F. Hayden, 35 Gorham St., plans the construction of a 70 x 100 ft. repair and service garage at 8 Sparks St. Estimated cost $45,000. R. C. Grovestein, 5 Brattle St., Archt.

Mass., Chelsea (Boston P. O.) — J. H. Reagan, 154 Lexington St., Cambridge, is receiving bids for the construction of a 1 story, 115 x 150 ft. repair and service garage on Second St. here. Estimated cost $50,000. Private plans.

Mass., Everett (Boston P. O.)—Merrimac Chemical Co., 148 State St., Boston, plans the construction of a 1 story cooperage shop, here. Estimated cost $40,000. Private plans. Owner will build by separate contracts.

Mass., Malden (Boston P. O.)—P. Levine, c/o J. Tuck, Park Square, Boston, Archt., plans the construction of a 1 story, 110 x 300 ft. garage on Pleasant St. here. Estimated cost $150,000. Owner will build by separate contracts. Noted Nov. 12.

Mass., Medford—Jackson & Newton Co., 105 Portland St., Boston, awarded contract for the construction of a 2 and 3 story shop for the manufacture of doors, windows and blinds at Myrtle Place here. Estimated cost $40,000.

Your machine-tool wants inserted here free of charge

Address
BUSINESS NEWS DEPARTMENT
McGRAW-HILL CO., INC.,
10th Ave. at 36th St., New York.

Mass., Quincy (Boston P. O.)—Eastern Wood Products Co., 56 Arlington St., Wollaston, will build a 1 story plant, here. Estimated cost $40,000.

Mass., Roxbury (Boston P. O.)—Atlantic Screen & Wood Products Co., 25 Vale St., awarded contract for the construction of a 1 story, 65 x 230 ft. factory including mill, garage, boiler house, etc., on Dochdale Road. Estimated cost $50,000.

Mass., South Boston (Boston P. O.)—C. I. Brink, Inc., 24 Gold St., plans the construction of a 2 and 3 story addition to plant for the manufacture of electric signs between Gold and Fourth Sts. Estimated cost $40,000. Architect not selected.

Mass., Springfield—R. Meyer, c/o Overland Springfield Co., had plans prepared for the construction of a 1 story, 60 x 126 ft. addition to sales, service and repair garage at South Main and Montpelier Sts. Estimated cost $40,000. R. B. Warner, 318 Main St., Archt.

Mich., Detroit—Cadillac Motor Car Co., 1860 Clark Ave., had plans prepared for the construction of a 2 story, 150 x 207 ft. addition to service station on Cass Ave. A. Kahn, 1000 Marquette Bldg., Archt.

Mo., Joplin—Southwestern Sash & Door Co., awarded contract for the construction of a 1 story, 100 x 200 ft. mill. Estimated cost $50,000. Private plans.

Mo., St. Louis—Standard Underground Cable Co., 4125 North Kingshighway Blvd., awarded contract for the construction of a 2 story, 60 x 80 ft. addition to factory.

N. Y., New York—V. Valentine, c/o Gronenberg & Leuchtag, 450 5th Ave., Archts., is having plans prepared for the construction of a 6 story, 100 x 150 ft. garage at 540 West 58th St.

N. C., Asheville—National Casket Co., W. H. Donnell, Mgr., 3 Park Square, Boston, Mass., plans the construction of a plant at Woodfin near here. Estimated cost $500,000.

O., Cleveland—The Cream Cone Machine Co., J. W. Taylor, Pres., 5800 Hough Ave., plans the construction of a 4 story addition of a 1 story, 25 x 65 ft. addition to Architect not selected.

O., Cleveland — Eaton Axle Co., C. F. Ochs, Gen. Mgr., 735 East 140th St., awarded contract for the construction of a 1 story, 80 x 152 ft. factory and storage building. Estimated cost $40,000.

O., Cleveland—Scranton Avenue Carriage Co., J. T. Hildebrand, Pres., 2339 Scranton Road, awarded contract for the construction of a 1 story, 25 x 65 ft. addition to factory. Estimated cost $40,000.

O., Columbus—Bresnohan Realty Co., 1 South Fourth St., is receiving bids for the construction of a 2 story, 68 x 118 ft. factory and display building on Goodale St. for Superior Heating Co., 75 North Front St. Estimated cost $45,000. Architect not selected.

O., Fostoria—Seneca Wire & Mfg. Co. will receive bids until Jan. 1, for the construction of a 1 story, 160 x 375 ft. addition to factory to house a new department. Estimated cost $75,000.

Pa., Philadelphia — J. Hyman & Son, Tioga and Livingston Sts., awarded contract for the construction of a 1 story, 120 x 200 ft. shop and storage building at Tioga and Almond Sts. Estimated cost $75,000.

Pa., Philadelphia — R. R. Lloyd & Co., 105 North 22nd St., awarded contract for the construction of a 1 story, 60 x 150 ft. woodworking factory on Lembrooke Ave.

Pa., Philadelphia—Packard Motor Co., 319 North Broad St., awarded contract for the construction of a 200 x 265 ft. sales and service building at 3221-3239 North Broad St. Estimated cost $1,000,000.

Pa., Philadelphia — W. Reisbond, 4442 Ludlow St., awarded contract for the construction of a 2 story, 19 x 50 ft. structural steel shop at 55th and Arch Sts. Estimated cost $18,000.

Pa., Pittsburgh—J. Feigenbaum, 4th Ave., is receiving bids for the construction of a 4 story garage. Estimated cost $250,000. Private plans.

R. I., Westerly—Water Works Dept. will build a pumping station and machine shop. Estimated cost $25,000. W. T. Arnold, 34½ West Main St., Meriden, Conn., Engr. Noted Nov. 19.

Tenn., Chattanooga — Corley Mfg. Co., 1901 Williams St., plans the construction of a plant for the manufacture of sawmill equipment, saw rigs, etc. Estimated cost $50,000.

W. Va., East Steubenville (Willsburg P. O.)—Wheeling Steel Corp., Wheeling Steel Corporation Bldg., Wheeling, plans the construction of 57 new by-product ovens to increase capacity of plant from 1,000 to 1,700 tons daily. Estimated cost $1,000,000. Private plans.

Wis., Janesville—County Board plans the construction of a machinery shop and storage house, here. $10,000. C. E. Moore, County Hy. Comr.

Wis., Milwaukee—International Harvester Co., 217 Oregon St., awarded contract for the design and construction of a 1 story, 145 x 200 ft. unit to its plant. Estimated cost $125,000.